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NATIONAL DAM INSPECTION PROGRAM. DEHART DAM (INVENTORY NUMBER N--ETC(U)
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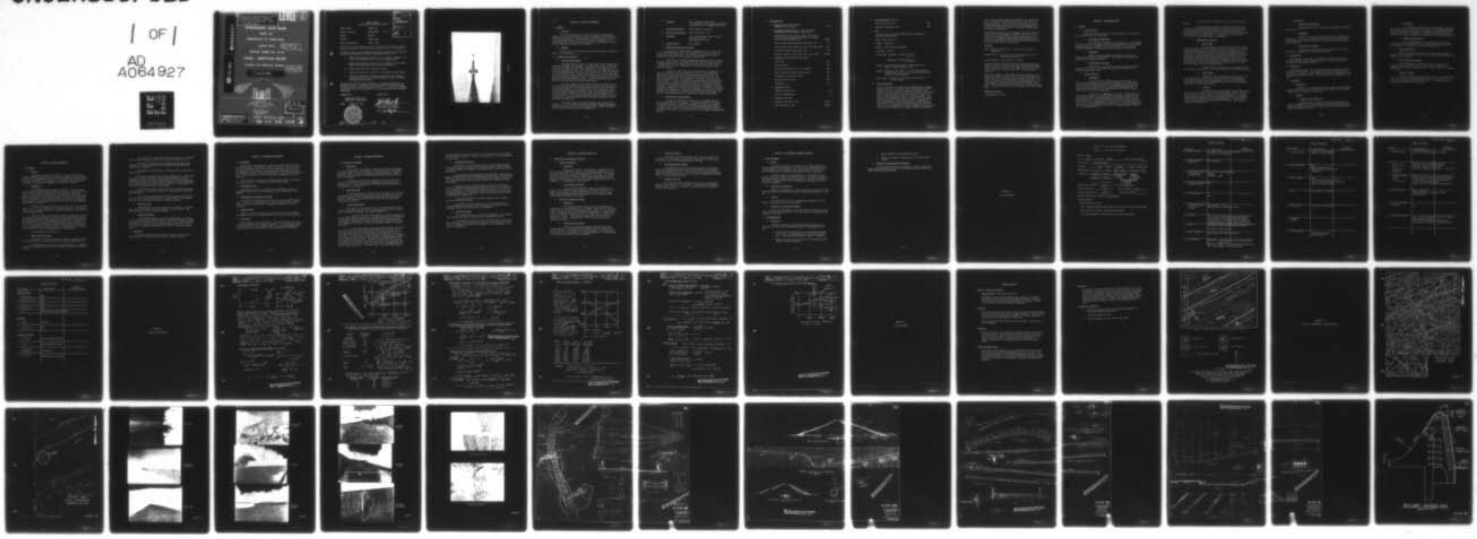

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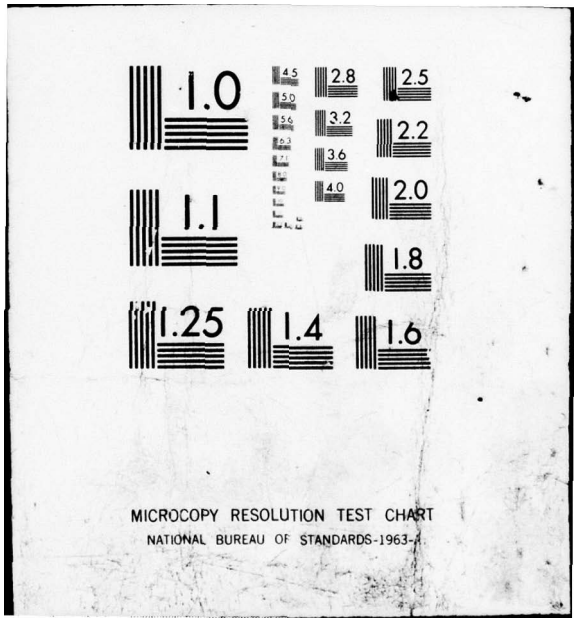
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(6) National Dam Inspection Program. Dehart Dam (Inventory Number NDS-PA-561), Susquehanna River Basin, Clarks Creek, Dauphin County, Pennsylvania. Phase I, Inspection Report.

LEVEL II (1)

SUSQUEHANNA RIVER BASIN

DEHART DAM

COMMONWEALTH OF PENNSYLVANIA

DAUPHIN COUNTY

(12) 54 p

INVENTORY NUMBER NDS PA-561

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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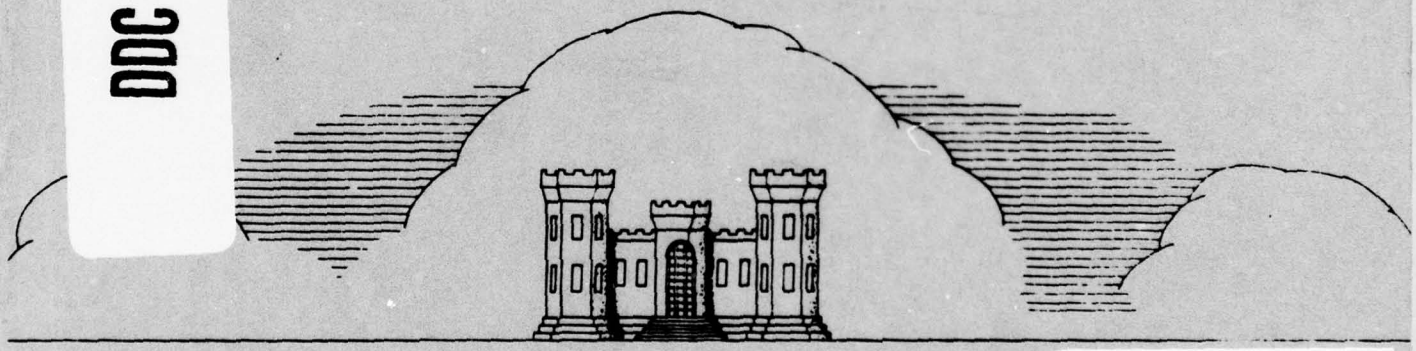


Prepared For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland

by
BERGER ASSOCIATES, INC
CONSULTING ENGINEERS
HARRISBURG, PA.

AUGUST 1978

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: DEHART DAM

State & State No. PENNSYLVANIA - 22-9

County: DAUPHIN

Stream: CLARKS CREEK

Date of Inspection: July 7, 1978

Based upon a visual inspection, past performance and available engineering data, the dam and its appurtenants appear to be in good condition.

In order to assure the continued satisfactory operation of this dam, the following recommendations should be implemented by the owner:

1. Observe and record the behavior of the apparent seepage at the toe of the embankment left of the left spillway wall.

2. Repair the spalling at the top of the spillway outlet channel walls and deteriorated slabs as soon as possible.

3. Remove vegetation from embankment slopes.

4. Examine the hydraulic capacity of the spillway outlet channel.

5. Develop and implement a formal surveillance and downstream warning system to be used during periods of high or prolonged continuous precipitation.

In accordance with the Corps of Engineers' evaluation guidelines, the spillway capacity is inadequate for passing the PMF (Probable Maximum Flood) peak inflow without overtopping the dam. It is, however, capable of passing 67% PMF and, therefore, it is not considered to be seriously inadequate.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATEL August 25, 1978

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
RODNEY VINCENT HOUSEAL
ENGINEER
No 4756-E

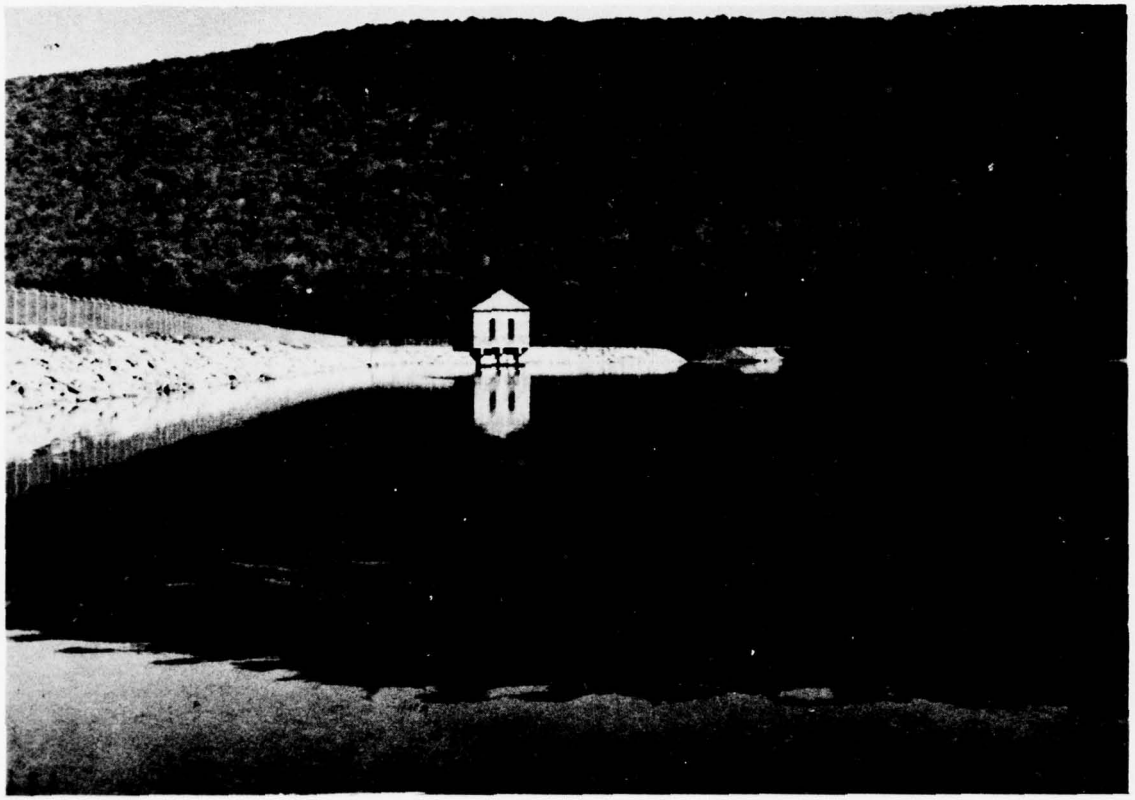
Rodney V. Houseal

APPROVED BY:

John H. Kenworthy

JOHN H. KENWORTHY
LTC, Corps of Engineers
Acting District Engineer

DATE: 25 Aug 78



OVERVIEW

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States. The Phase I Inspection and Report is limited to a review of available data, a visual inspection of the dam site and the basic calculations to determine the hydraulic adequacy of the spillway.

B. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Dam and Appurtenances

The DeHart Dam is located in Clarks Valley about fourteen miles northeast of Dauphin, Pennsylvania. The dam breast is about 2,000 feet long, 105 feet high, and 600 feet in thickness at the base, with a 30 feet wide roadway on the top. The spillway is 11 feet deep and 110 feet wide and drops down 100 feet into a stilling basin to reduce the velocity of the overflowing water. When the reservoir is full, at 644 feet above sea level, water is backed up four and one-half miles and contains seven and one-half billion gallons of water. It receives its water from Clarks Creek and twenty-three smaller creeks. The watershed covers approximately 21.61 square miles of mostly wooded areas.

The intake tower is located about 100 feet upstream from the dam breast and has openings at four different levels for a selection of the best water quality. The selected water passes through two seven-foot diameter gates, a 3/4 inch mesh screen, a 1/4 inch mesh screen, a concrete tunnel through the dam breast, and a 42-inch diameter line to the control house. There is also a 24-inch pipe discharging at the stilling pool to blow off high concentrates from the bottom of the dam. Two monorail cranes in the intake tower control the operation of the screens and the baffles.

The control house is a stone building of two stories and a basement. A 24-inch diameter blowoff line passes through the basement to the stilling pool, and a 42-inch diameter line carries the water to the reservoirs in Reservoir Park in Harrisburg.

B. Location: Rush Township, Dauphin County
U.S. Quadrangle, Grantville, Pennsylvania
Latitude 40° -25.7', Longitude 76°-44.8'

C. Size Classification: Large (height is 105 feet)

D. Hazard Classification: High (See Section 3.1.E)

E. Ownership: City of Harrisburg, Bureau of Water
1149 Forster Street
Harrisburg, Pa. 17120

F. Purpose of Dam: Water Supply

G. Design and Construction History

The William T. DeHart Dam was completed on July 1, 1940, and raw-treated mountain water was first delivered to the city during the latter part of the same year. The facility was designed by Gannett, Eastman and Fleming, Inc., Harrisburg, Pennsylvania.

Until 1948, the mountain supply was augmented with river water through an older system. On January 23, 1948, the old system was discontinued entirely; the pumping station and filter plant were placed on a standby basis, but were continued to be maintained operable in the event of emergency.

The post-war years have also witnessed major improvements. In 1950, the surface of the open reservoir in the city was completely covered with a thick layer of reinforced concrete over the old brick work and an 18-inch wall was erected around the open reservoir. In 1954, an additional four feet was added to the height of the spillway of the DeHart Dam, in order to provide for an additional billion gallons of water storage. In 1959, the pumping station was thoroughly overhauled. The old steam engines and boilers were converted to new electric-power equipment. The standby system for water from the Susquehanna was ready to operate immediately in the event of emergency. In 1958, a new chlorine building was constructed at DeHart Dam and modern lime-feed and chlorine equipment was installed. Following the 1972 tropical storm Agnes, the use of the Susquehanna River as a standby system was discontinued.

H. Normal Operating Procedures

The dam was constructed for use as a water supply reservoir and is being used for that purpose. The water is supplied to the City of Harrisburg through a distribution system by gravity. The primary distribution line to the city is a 42-inch main approximately 19 miles in length. The water is collected from this main at Reservoir Park in Harrisburg from which it is delivered to the city through its distribution system.

1.3 PERTINENT DATA

A.	Drainage Area (square miles)	
	Computed for this report	21.3
B.	Discharge at Dam Site (cubic feet per second)	
	See Appendix B for hydraulic calculations	
	Maximum known flood, June 22, 1972, from records for the U.S.G.S. gaging station which is located 0.3 mile downstream from dam	4,800
	Outlet works low pool outlet at pool Elev. 555	35
	Outlet works at pool level Elev. 644 (spillway crest)	188
	Warm water outlet at pool Elev. 631	80
	Spillway capacity at pool Elev. 655 (top of dam)	16,900
C.	Elevation (feet above mean sea level)	
	Top of dam	655
	Spillway crest	644
	Upstream portal invert (6' x 7' conduit)	551
	Downstream portal invert (24-inch pipe)	551
	Streambed at centerline of dam	551
	Maximum tailwater about	556
	Normal pool	644
D.	Reservoir (miles)	
	Length of normal pool	4.5
	Length of maximum pool	5.5
E.	Storage (acre-feet)	
	Spillway crest (Elev. 644)	23,700
	Top of dam (Elev. 655)	30,800

F. Reservoir Surface (acres)

Top of dam (Elev. 655)	690
Spillway crest (Elev. 644)	592

G. Dam

For plan view and typical section, refer to Appendix D, Plate Nos. VII and VIII.

Type: Rolled earthfill.

Length: 2,000 feet.

Height: 105 feet above streambed.

Top Width: 30 feet.

Side Slopes: Upstream - variable 2H to 1V
3H to 1V

Downstream - variable 2H to 1V
3H to 1V

Zoning: Upstream and downstream - rolled coarse fill.
Center - rolled impervious fill.

Cutoff: Impervious core trench - 21 feet wide at bottom.
Concrete cutoff wall in core trench extending downward into rock foundation.

Grout Holes: Drilled to 30 feet below rock surface on 3 feet centers.

H. Outlet Facilities

Water is taken into the intake tower through eleven openings. See sheets 2 and 3 of Appendix B for a description of these openings. All but one of the openings have shutter-type closures which are inserted or removed by means of an overhead crane. These shutters are provided to make it possible to select water from various levels. The intake tower is composed of two, independent, identical sides, each side having three compartments. Water enters the first compartment on each side through the selected opening(s), passes through a sluice gate to a second compartment, through a second sluice gate to a third compartment, through a removable screen and on into two 7-foot diameter steel pipes through the dam embank-

ment. After passing through the embankment, the right-hand pipe is reduced to 36-inch diameter for the 690-foot run to the control house. There it is further reduced to 24-inch diameter and after passing through a valve, continues on 75 feet more to the stilling basin. This pipe is used to make releases to Clarks Creek.

After passing through the dam embankment, the left-hand pipe reduces to 42-inch diameter, continues on 690 feet to the control house, passes through a valve, and continues on 20 miles to the Harrisburg, Pennsylvania distribution system. A crossover is provided so that the Harrisburg supply pipe may also take water from the 36-inch pipe.

I. Spillway

Type: Uncontrolled ogee weir. (see Plate IX, X and XI, Appendix D).

Length of Weir: 111.92 feet with side walls that have an outward slope of 1H to 12V.

Crest Elevation: 644 (640 prior to 1954).

Upstream channel: Weir and upstream channel have been excavated in rock about 200 feet from right end of dam embankment. Present channel is about 120 feet wide by 120 feet long and is about 9 feet deep at normal pool stage. Bottom surface is loose rock.

Downstream channel: The spillway chute has a relatively flat slope as it descends about 93 feet in a horizontal distance of about 1,400 feet. The width narrows slightly from about 112 feet at the weir to about 90 feet at the stilling pool. It is constructed of concrete and has 8-foot high training walls. The stilling pool measures about 105 feet by 93 feet by 6-feet deep. There is no sign of erosion downstream from the stilling pool.

J. Regulating Outlets

See paragraph "H" above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Data Available

Numerous studies were made in 1937-38 leading to the selection of the present site for this project.

1. Hydrology and Hydraulics

The hydrologic and hydraulic data available in the PennDER files were limited. Frequency curves, unit hydrographs or flood routing information were not available. There is reference to the spillway having the capacity to pass 13,500 cfs with one foot of freeboard.

2. Embankment

Detailed design drawings are available defining the features and makeup of the embankment. The files did not contain any calculations or design criteria.

3. Appurtenant Structures

Design criteria and data for the appurtenant structures were not in the files. The construction drawings are suitable for evaluating these facilities.

B. Design Features

1. Embankment

The 1938 plans by Gannett, Eastman and Fleming, Inc., show the dam embankment as a two-zoned structure with a rolled impervious fill in the central portion of the embankment and rolled coarse fill as the outer zone on both the upstream and downstream sides. A rock surface is provided on both the upstream and downstream slopes, which tie to a rock toe in each case.

The top of the embankment is 30 feet in width and has a crushed stone surface. The central impervious zone is sloped 1H to 1V on both upstream and downstream sides. The rolled coarse fill on the upstream side has a varied slope beginning with 2H to 1V to elevation 640; 2.5H to 1V to elevation 610; 3H to 1V to elevation 580; and 3.5H to 1V to the toe of the embankment at elevation 551. A variable slope also makes up the downstream side with 2H to 1V to elevation 505; and 3H to 1V to the downstream toe.

The rock sizes are indicated as 18 to 48 inches on both slopes.

A cutoff trench is excavated to the rock surface and filled with the impervious zone material. Grouting of the rock foundation was carried to a depth of 30± feet below the rock surface. A concrete cutoff wall was constructed directly over the rock grouted area at the center of the dam section. It is seated into the rock and extends 4 to 10 feet upward into the embankment.

2. Appurtenant Structures

a. Intake Tower

The intake tower is located about 100 feet upstream from the embankment and is accessible by way of a bridge. The tower is founded on rock and its deck is 102 feet above the foundation. It is constructed of reinforced concrete and contains two 84-inch diameter pipes which carry the water supply from the tower chamber to the chlorination and fluoridation plant located directly downstream from the embankment. These pipes are located at the bottom of the tower well. Four 3-feet by 4-feet inlet openings are provided at various elevations; Elevations 627, 616.25, 604.5 and 594.75, allowing water to be taken into the chamber from these varying levels.

Outflow from the 84-inch pipes is controlled by 84-inch diameter sluice gates. Flow into the tower is controlled by baffles.

b. Outlet Works

There is no outlet structure at this facility. The flow from the inlet tower goes to the chlorination and fluoridation plant just downstream from the embankment. A 24-inch pipe carries a steady flow of water from this building directly to the stilling basin at the end of the spillway channel.

c. Spillway

The spillway is an uncontrolled concrete ogee section with a crest elevation of 644. The spillway length is about 110 feet and its crest is 11 feet below the top of the embankment. A concrete spillway outlet channel carries the spillway discharge to the stilling basin located approximately 1400 feet downstream. A roadway bridge spans the channel 600'± downstream from the spillway. The channel is curved and superelevated.

C. Design Data

1. Hydrology and Hydraulics

PennDER's files did not contain any hydrologic or hydraulic design data.

2. Embankment

There was no design information or criteria regarding the embankment in the files. The evaluation and assessment of this feature is based upon the information shown on the construction drawings and the visual inspection.

3. Appurtenant Structures

Design data or criteria were not available in the files. Evaluation is based upon the construction drawings.

2.2 CONSTRUCTION

The available construction information is limited to reports on file with PennDER. Field compaction reports are included for borrow materials and embankment materials.

2.3 OPERATIONS

The purpose of this dam is to supply domestic water for the City of Harrisburg, Pennsylvania. Its operation and historic background are available in a brochure entitled "History and General Information of the Harrisburg Water System", 1967. This publication is available from the City.

2.4 EVALUATION

A. Availability

A complete set of design drawings is available in the PennDER files including those for the raising of the spillway. Detailed calculations are not available in these files.

B. Adequacy

1. Hydrology and Hydraulics

The files did not contain any pertinent hydrologic or hydraulic information. The evaluation is based upon physical features of the facilities and the Corps of Engineers criteria for assessing the hydraulic adequacy of the dam.

2. Embankment

The information available on the embankment is limited to the sections shown on the construction plans. These sections are suitable for assessing the adequacy of the geometry of the dam but are not of sufficient detail to determine the actual stability of the slope. Based upon the visual inspection, it appears to be entirely satisfactory.

3. Appurtenant Structures

Like the embankment, the information relative to the intake structure, the spillway and its outlet channel are contained on the drawings. The design can be judged from these data.

C. Operating Records

Operating records consist mainly of water supply demands, treatment, etc. Maintenance records are available regarding repairs and upkeep of the facilities.

D. Post Construction Changes

The major change to this facility was the raising of the spillway crest elevation from 640 to 644 in 1954. Replacement of damaged spillway channel slabs was made as a result of the 1972 tropical storm Agnes.

E. Seismic Stability

The dam is located in Seismic Zone 1 and it is considered that the static stability with normal safety factors is sufficient to withstand minor earthquake induced dynamic forces. No calculations or studies have been made to confirm this.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of this dam is good. The facilities and the surrounding area are well maintained. Based upon visual observations of the physical plant, there are no indications of major concern. The visual checklist is in Appendix A. Photographs taken during the inspection are reproduced in Appendix D, Plates III through VI.

B. Embankment

The embankment shows no signs of distress. The rock slopes, both upstream and downstream are relatively uniform considering the size of rock (18 to 48 inches) which cover these surfaces. Heavy fern growth is found between the nested rocks on the downstream slope. Some light fern growth is located near the top of the slope on the upstream slope. The presence of this vegetation does not have any influence on the stability of the embankment; however, some trees on the downstream slope should be removed.

A small wet area was observed to the left of the left spillway wall at the toe of the embankment on the downstream side. This does not appear to be a serious condition, but should be observed by the owner as a precautionary measure.

There was water flowing from the natural ground above the dam just beyond the left abutment. This water flows toward the embankment then along and probably through the rock toe toward the low point along the natural ground. Any underseepage that might occur is apparently controlled by the rock toe and is combined with the other uphill drainage. A small stream was observed flowing through the rocks along the toe of the embankment to near the center of the dam where it is picked up by an 18-inch ± pipe and discharged into a small stream.

Other seepage was not detected.

C. Appurtenant Structures

Appurtenant structures include the spillway, spillway channel and intake structure. There is no outlet structure at this facility.

The spillway was observed to be in good condition. Its dimensions were checked and found to be in accordance with the 1954 modifications.

The cutoff wall at the right abutment was found to be exposed at the surface indicating a short low section just behind the wall.

Water was not flowing over the spillway at the time of the inspection. The water surface was approximately 8-inches below the spillway crest elevation.

The approach to the spillway is directly from the lake and is unobstructed.

With the exception of some surface weathering on several slabs and exposed joints, the slabs of the spillway channel are in good condition. The walls are also in good condition. Some heavy spalling was observed at the top of some of the wall sections at the construction joint. These conditions do not impair the function of the spillway but preventative maintenance should be encouraged.

New slabs placed as a result of the 1972 tropical storm Agnes were observed to be in excellent condition. Weep holes were placed in these new slabs.

The intake structure houses the control gates used to operate this facility. It was observed to be in good condition. Maintenance and care of the mechanical equipment is frequent and good.

D. Reservoir Area

Sedimentation has not been reported as a problem. The reservoir slopes are forested and are not subject to heavy erosion. The general reservoir area is in good condition.

E. Downstream Channel

The downstream channel, below the stilling basin, is considered as typical mountain stream terrain. A YMCA camp and about 15 homes are within the flood plain of the creek in the first 6 miles downstream from the dam. Failure of this dam could cause the loss of more than a few lives. The hazard classification of "High" is, therefore, appropriate.

3.2 EVALUATION

The observed condition of this facility was good. There are no major points of concern which were obvious to visual inspection.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

This facility was constructed to serve as a water supply for the City of Harrisburg, Pennsylvania. Water is taken from the lake through two 84-inch diameter pipes to a plant just downstream from the toe of the embankment. Here chlorine and fluoride are added before the water is transported through a 42-inch diameter main to the Harrisburg Reservoir Park. From this point the water is distributed throughout the City as required.

A low flow weir is provided to assure sufficient flow to maintain the downstream creek. Readings are recorded twice weekly.

4.2 MAINTENANCE OF DAM

Maintenance of the dam is limited to the embankment, which is apparently stable, and the uncontrolled spillway and spillway outlet channel.

4.3 MAINTENANCE OF OPERATING FACILITIES

The dam and the appurtenant facilities are under constant surveillance. There is a resident operator living on the premises. Maintenance is carried out as required. Mechanical equipment is serviced regularly.

4.4 WARNING SYSTEM

There is no formal warning system or plan in operation; however, the operator resides on the premises and is in contact with Harrisburg.

4.5 EVALUATION

This facility is well maintained. All features appear to be functioning as designed with no signs of neglect. The only exception would be the absence of a formal warning plan to alarm the downstream population in the event of continous or high concentrations of rainfall.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analyses available from PennDER for DeHart Dam were not very extensive. No frequency curve, unit hydrograph, nor flood routings were submitted by the designer to PennDER. There was a statement that the spillway would pass 13,500 cfs with one foot of freeboard.

Area-capacity curves and a spillway rating curve have been developed for this report using the information in the construction drawings and on U.S.G.S. topo sheets. Hydraulic computations made for this report are in Appendix B.

B. Experience Data

In the period that the dam has been in existence, from 1940 to the present, the maximum flood was that of June 22, 1972, when the flow was about 4,800 cfs. The spillway passed that flood but some of the concrete slabs composing the floor of the lower end of the spillway chute were torn loose.

C. Visual Observations

On the date of the inspection, the following conditions were observed that might indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event.

1. Since the spillway chute experienced serious difficulties with a flow of 4,800 cfs, and since the only change has been the addition of some under-slab drainage and the replacement of the torn-up chute floor slabs, it appears to be fairly certain that the maximum spillway weir discharge of 16,900 cfs would cause extensive damage to the spillway chute.

2. A one lane, single span highway bridge crosses the spillway chute about 600 feet downstream from the weir. The walls of the chute are 8-feet high but the underside of the bridge beam is only 6-feet above the chute floor on the right side and only 7.6 feet on the left side. A witness said the water touched the underside of the bridge at the peak of the 1972 flood. This appears to be questionable since the chute has a slope of about 7 percent and the head on the weir was only about 5 feet; however, the chute has a long curve to the left and the high level of the water might have been due to a standing wave (see Brater & King, Page 9-17). At higher flows, this bridge might hasten

the destruction of the spillway chute if the flow capacity as indicated by the witness is correct. A study of flow patterns in the chute appears to be in order.

D. Overtopping Potential

This dam has a size classification of "Large" (105 feet high and 30,800 acre-feet of storage) and a hazard potential classification of "High" (A YMCA camp and about 15 low-lying homes in the first 6 miles downstream).

The Recommended Spillway Design Flood (SDF) for a dam with the above classifications is the Probable Maximum Flood (PMF). The estimated PMF peak inflow for this site is 39,400 cfs and the spillway capacity at top of dam level (Elev. 655) is about 16,900 cfs or 43 percent of PMF peak inflow.

Comparison of the estimated PMF peak inflow of 39,400 cfs, with the estimated ultimate spillway capacity of 16,900 cfs, indicates that the potential for overtopping of DeHart Dam exists. An estimate of the storage effect of the reservoir shows DeHart Dam does not have the storage available that is necessary to pass the PMF peak inflow without overtopping (see Appendix B).

The project does have the spillway capacity and storage to pass the 1/2 PMF peak inflow.

The engineering firm employed by the owner furnished the information that the spillway weir was designed to pass the "C" curve discharge (13,500 cfs) with one foot of freeboard.

E. Spillway Adequacy

The spillway capacity is considered inadequate, as the project will not pass the PMF peak inflow without overtopping the dam.

Calculations in Appendix B show that DeHart Dam and Reservoir have sufficient spillway and storage capacity to pass 67 percent of the PMF. The spillway is, therefore, considered to be inadequate, but not seriously inadequate.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Embankment

There were no signs or indications of embankment settlement or slope sloughage or erosion. The embankment appeared to be in very good condition. Excessive seepage was not observed. The seepage at the toe on the left side of the downstream slope appears to be from natural ground above the dam; but could include some amount of under seepage. In either case, it does not present a problem relative to the stability of the embankment at this time.

2. Appurtenant Structures

Visual observations did not reveal any problems with regard to the stability of the spillway or the intake structures. The damage to the spillway channel slabs during the 1972 tropical storm Agnes, high discharge indicates that future high discharge may again cause similar problems in the channel.

B. Design and Construction Data

1. Embankment

The available plans indicates that the embankment was constructed on firm foundation with a concrete cutoff wall set into rock and grouted to 30± feet below the rock surface. There is no significant amount of compressible material beneath the embankment to induce settlements. The slopes, ranging from 2H to 1V to 3H to 1V are typical for this type structure. The inspection observations indicate that the condition is stable. Seepage control with a rock toe installed is apparently effective.

2. Appurtenant Structures

A review of the design drawings indicates good engineering design for the spillway and the intake structure, except that weep holes were not included in the original design. The modification to the spillway is also judged to be designed properly. Its performance in the past is testimony to this conclusion.

C. Operating Records

The resident operator indicated that, with the exception to the damage to the spillway channel slabs during the 1972 storm, there have been no serious operating problems at this dam.

D. Post Construction Changes

As indicated earlier, the only major change to the original design and construction of this dam was the raising of the spillway crest elevation from 640 to 644. This was done to increase the storage capacity of the reservoir as a result of in-depth engineering studies by the City's engineering consultant.

E. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT & REMEDIAL MEASURES

7.1 DAM ASSESSMENT

A. Safety

The visual inspection, the review of the design drawings and the operational history indicates that the dam is in good condition. It is well maintained and attended. There are no signs of distress that would interfere with the continued performance of these facilities.

The major concern is the inadequacy of the spillway to pass the PMF peak inflow without overtopping the dam. The spillway capacity plus the available storage can pass 67 percent of the PMF. According to the Corps of Engineers criteria, the spillway is inadequate, but not seriously inadequate.

B. Adequacy of Information

Sufficient information is found in the files, plans and records regarding design and performance to make a reasonable assessment of this dam.

C. Urgency

It is considered that the recommendations suggested in this report be implemented as soon as possible.

D. Necessity for Additional Studies

Based upon the results of this inspection the hydraulic calculations and the past performance of this dam, additional studies are not required at this time.

7.2 RECOMMENDATIONS

A. Facilities

In order to assure the continued satisfactory operation of this dam, the following recommendations should be implemented by the owner:

1. Observe and record the behavior of the apparent seepage at the toe of the embankment left of the left spillway wall. Take appropriate remedial measures if indicated.

2. Repair the spillway walls and slab of the spillway outlet channel as soon as possible.

3. Remove vegetation from embankment slopes.

4. Examine the hydraulic capacity of the spillway outlet channel.

B. Operation and Maintenance Procedures

The owner should develop and implement a formal surveillance and downstream warning system to be used during periods of high or prolonged continuous precipitation.

APPENDIX A

VISUAL INSPECTION

CHECK LIST - DAM INSPECTION PROGRAM

PHASE I - VISUAL INSPECTION REPORT

NAD NO. 561

PA. ID # 22-9 NAME OF DAM DeHart HAZARD CATEGORY High

TYPE OF DAM: Rolled Earthfill

LOCATION: Rush TOWNSHIP Dauphin COUNTY, PENNSYLVANIA

INSPECTION DATE 7-7-78 WEATHER Sunny - Warm TEMPERATURE 80's

INSPECTORS: H. Jongsma - A. Bartlett Corps of Eng'r
R. Houseal - R. Steacy
R. Strong
E. Hecker
PennDER
Jim Donato
P. Cardosik
City of Harrisburg
C. Zimmerman
H.G. Corty

NORMAL POOL ELEVATION: 644.0 AT TIME OF INSPECTION:

BREAST ELEVATION: 655.0 POOL ELEVATION: 643.2

SPILLWAY ELEVATION: 644.0 TAILWATER ELEVATION: -

MAXIMUM RECORDED POOL ELEVATION: 649.5 (1972)

GENERAL COMMENTS:

Spillway raised in 1954.

1972: Damaged spillway channel slabs near the end of the spillway channel.

Weirs read twice weekly - below spillway channel.

No seepage problems of record since the dam was constructed.

VISUAL INSPECTION

EMBANKMENT	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. SURFACE CRACKS	No cracks or other distress observed on top or on the slopes.	
B. UNUSUAL MOVEMENT BEYOND TOE	None observed.	
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None - rock slopes appear very stable. Abutments - good.	
D. VERTICAL & HORIZONTAL ALIGNMENT OF CREST	Good	
E. RIPRAP FAILURES	None	
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Left abutment - sound. Right abutment with spillway sound.	
G. SEEPAGE	Left of left spillway wall slight seepage from toe of slope - no steady flow; also seepage along rock toe - from left abutment toward the center of the dam. Appears to be coming from the hillside above the dam. Outlet pipe from toe to daylight at small stream below toe of dam.	
H. DRAINS	Toe drain to small stream.	
J. GAGES & RECORDER	Staff gage on the intake structure.	
K. COVER(GROWTH)	Downstream: rock with heavy fern growth and some small trees. Upstream: Dumped rock - light fern growth near top. Top: Stone roadway - chain link fence.	

DAM NO. NAD 561

VISUAL INSPECTION

OUTLET WORKS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. INTAKE STRUCTURE	Concrete and stone masonry building. Good condition.	
B. OUTLET STRUCTURE	None. Water flows through 84" diameter pipes to plant just below dam.	
C. OUTLET CHANNEL	None. 24" pipe discharges to stilling basin. Low flow control. 24" comes off of 36" line in tower.	
D. GATES	Five controls + baffels.	
E. EMERGENCY GATE	24" pipe as in "C" above.	
F. OPERATION & CONTROL		
G. BRIDGE (ACCESS)	Concrete with railing - good condition.	

DAM NO. NAD 561

VISUAL INSPECTION

SPILLWAY	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. APPROACH CHANNEL	Directly from lake to spillway between embankment sections.	
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Ogee section - 11' below top of dam. Spillway length - 110 feet. (approx.) Water not flowing over spillway. Cutoff wall exposed on right side - down about 1'±.	
C. DISCHARGE CHANNEL Lining Cracks Spilling Basin	Spalling on wall at end of sloped section on left side at top plus several others along the entire channel. Slabs in good condition. Curbed, superelevated channel Cracks in top of right spillway sloping wall.	
D. BRIDGE & PIERS	None at spillway. Concrete bridge over spillway channel. Good condition.	
E. GATES & OPERATION EQUIPMENT	None	
F. CONTROL & HISTORY	1972 - Slabs destroyed at lower end of channel. Repairs have been made. Some slabs are eroded where 30" diameter pipes enter the channel. Aggregate exposed.	

DAM NO. NAD 561

VISUAL INSPECTION

MISCELLANEOUS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
INSTRUMENTATION		
Monumentation	None	
Observation Wells	None	
Weirs	None	
Piezometers	None	
Other	Staff gage on control structure	
RESERVOIR		
Slopes	Forested	
Sedimentation	None	
DOWNSTREAM CHANNEL		
Condition	Natural Mountain Stream	
Slopes	Natural Mountain Growth	
Approximate Population	More than 20	
No. Homes	YMCA Camp plus 15± homes	

APPENDIX B

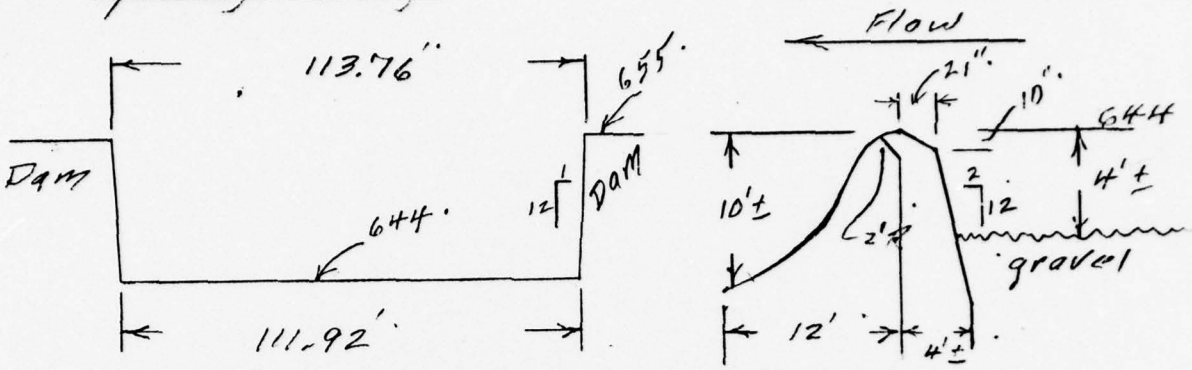
HYDROLOGY/HYDRAULICS

PROJECT Dam Investigation SHEET NO. 1 OF 6

SUBJECT DeHart Dam - Clark Creek ID No. 561

COMPUTED BY RES DATE 7-6-78 CHECKED BY JJP 7-11-78

Spillway Rating



U.S.G.S. operates a gaging station 0.3 mile downstream from the dam. For the flood of June 22, 1972, the USGS determined the peak discharge by making a survey of high water marks left by the pool upstream from the dam and by surveying the spillway weir. The results they obtained are as follows:

Head on weir = 4.97 ft. (Pool elev. 648.97)

Discharge = 4,800 cfs.

"C" = 3.83

Interviews with two employees at the dam gave heads of 66" and 72" (5.5 ft. and 6.0 ft). It is felt that the USGS figures had a better basis and they have been used in this report.

Pool elevation 655 (top of dam)

"C" = 4.1

H = 11.

$\frac{11}{4.97} = 2.21$

$L = \frac{111.92 + 113.76}{2} = 112.84'$

$\frac{C}{C_o} = 1.13$, $C = 1.13 \times 3.83 = 4.33$

Use 4.1

$Q = CLH^{3/2}$

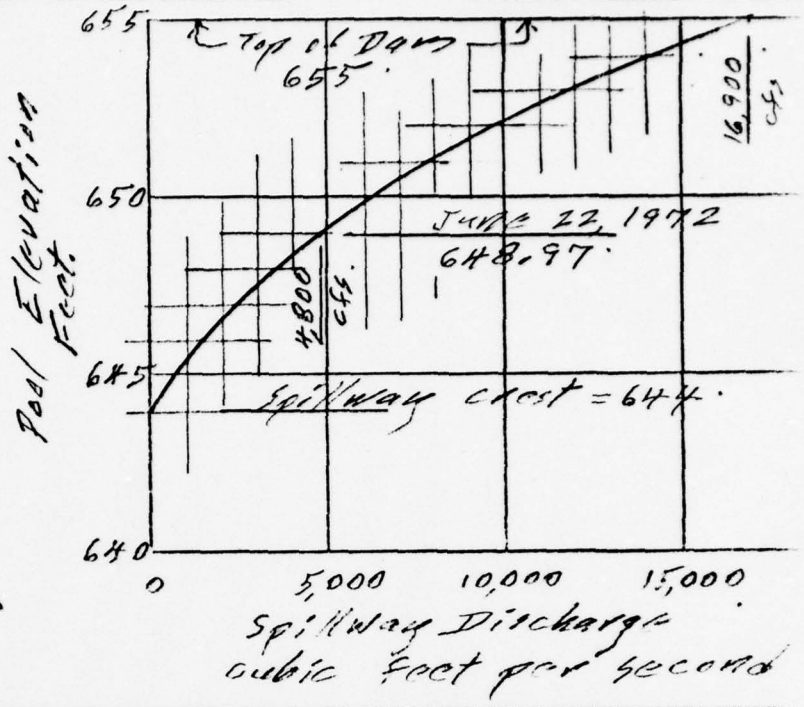
$= 4.1 \times 112.84 \times (11)^{3/2}$

$= 16,900$ cfs.

Ref. Brater + King 6th Ed. Page 5-29

See sheet 2 for graph of rating.

PROJECT Dam Investigation SHEET NO. 2 OF 6
SUBJECT DeHart Dam Clark Creek - ID No. 561
COMPUTED BY REL DATE 7-10-78 CHECKED BY JJR 7-14-78



Discharge of outlet works at low pool elev. 555

The lowest level outlet works are as follows:

Item	Distance (feet)	Conduit
Intake	—	—
Rect. conds.	210	2 6'x7' Rect. Conc. Conduits 6 compartments
Intake tower	30	
Steel pipes	415	2 7' dia. steel pipes
Reducers	10	7' dia. to 36" dia. on right 7' dia. to 42" dia. on left
Pipes	690	36" dia. on right 42" dia. on left
control house	—	Has cross over so 42" pipe can take water from 36" pipe
Pipe	15	24" CI pipe to discharge to stilling basin
Pipe	20 miles	42" dia C.I. pipe to Harrisburg water supply

Intake tower also has pairs of shuttered 3'x4' openings as follows:

Opening No.	Location (ft)	Invert elev.
No. 1	130	594.75
2	50	604.5
3	12	616.75
4	12	627.0

PROJECT Dam Investigation SHEET NO. 3 OF 6
SUBJECT DeHart Dam - Clark Creek - ID No. 561
COMPUTED BY RES DATE 7-10-78 CHECKED BY JJPJr 7-14-78

Discharge at outlet works at low pool (Cont.)
Finally there is a 42" square high level opening fitted with a gate valve which is normally used to take off water for domestic supply. Experience has shown that the high level water has the best quality.

To estimate low pool discharge to creek assume one 24" dia C.I. pipe 100 ft long.

$V = \frac{0.59}{n} \times d^{2/3} \times s^{1/2}$ $n = 0.015$ $d = 2$

$= \frac{0.59}{0.015} \times (2)^{2/3} \times (0.03)^{1/2}$ $s = \frac{555 - 552}{100}$

$= 39.3 \times 1.59 \times 0.173$ $= 0.03$

$= 11$ ft/sec $Q = 11 \times \pi \times (1)^2 = 35$ cfs

Discharge at outlet works at pool elev. 644 (spillway crest)

$V = \frac{0.59}{n} \times d^{2/3} \times s^{1/2}$ $s = \frac{644 - 552}{100} = 0.92$

$= \frac{0.59}{0.015} \times (2)^{2/3} \times (0.92)^{1/2}$

$= 39.3 \times 1.59 \times 0.959$

$= 60$ ft/sec, $Q = 60 \times \pi \times (1)^2 = 188$ cfs

Warm water outlet at pool elev. 631
Highest outlet is 3'x4' shuttered opening in Intake Tower with invert at Elev 627.

24" Pipe
$V = \frac{0.59}{n} \times d^{2/3} \times s^{1/2}$ $s = \frac{631 - 552}{100} = 0.79$

$= \frac{0.59}{0.015} \times (2)^{2/3} \times (0.79)^{1/2}$

$= 39.3 \times 1.59 \times 0.889$

$= 55.6$ ft/sec $Q = 55.6 \times \pi \times (1)^2 = 175$ cfs

3'x4' opening $Q = CA\sqrt{2gH} = 0.6 \times 12 \sqrt{64.4 \times 2} = 7.2\ (11.34)$

$= 82$ cfs

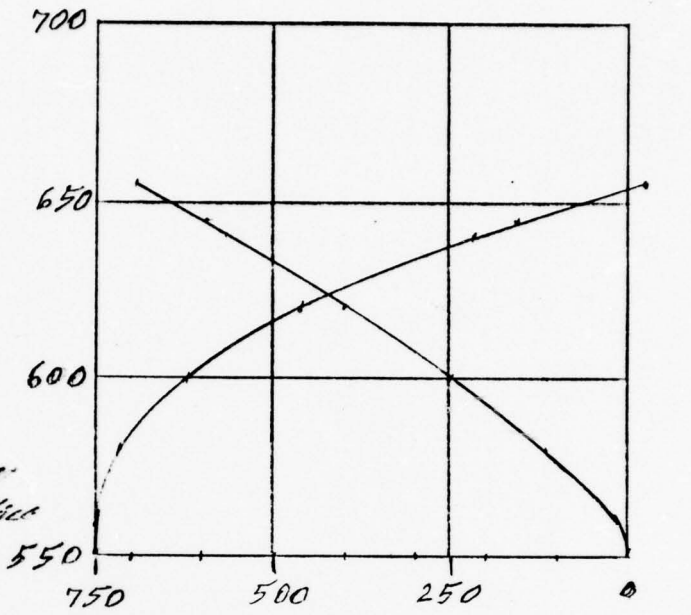
3'x4' opening controls. Use 80 cfs for warm water outlet

PROJECT Dam Investigation SHEET NO. 4 OF 6
SUBJECT DeHart Dam - Clark Creek - ID No. 561
COMPUTED BY RES DATE 7-10-78 CHECKED BY JJPJr 7-14-78

Area - Capacity curves

These curves are based on a surface area of 592 acres at normal pool elev. measured on USGS topo sheet and on a volume of 7,700,000,000 gals. found in PennDER files.

Note: The files contain a capacity curve from the city engineer's office which shows 6.0 billion gallons at elev. 644. All other sources show 7.7 billion gallons as total capacity.



Elev.	Area (acres)	Vol. (ac.-ft)	Tot. Vol. (ac.-ft)
551	0.	90.	0
560	20.	1400.	90.
580	120.	3700.	1490.
600	250.	6500.	5190.
620	400.	9700.	11690.
640	570.	2324.	21390.
644	592.	7051.	23714.
655	690.		30,765.

PMF Susquehanna Region 1
Drainage Area 21.3 sq. mi.
PMF = 1,850 cfs/sq mi.
= 39,400 cfs.

PMF volume = 26" = 53.33 x 26 x 21.3
= 29,500 acre feet.

PROJECT Dam Investigation SHEET NO. 5 OF 6
SUBJECT DeHart Dam Clark Creek ID No. 561
COMPUTED BY RES DATE 8-17-78 CHECKED BY

Overtopping Potential

PMF $\frac{\text{Max Spillway Discharge}}{\text{PMF Peak Inflow}} = \frac{16900}{39,400} = 0.43$

$\frac{\text{Req. Resv. Storage}}{\text{Vol. of Inflow}} = 0.57$ From short cut routing method furnished by Balt. Dist. C. of E.

Req Resv. Storage $= 0.57 \times 29,500$
$= 16,800$ acre feet

Avail storage $= 30,765 - 23,714 = 7,050$ ac. ft.

DeHart Dam would be overtopped by PMF

50% PMF $0.5 \times PMF = 0.5 \times 39,400 = 19,700$ cfs

Vol. Runoff $= 0.5 \times 29,500 = 14,800$ ac. ft.

$\frac{\text{Max Spillway Q}}{\text{0.5 PMF peak}} = \frac{16,900}{19,700} = 0.86$

$\frac{\text{Req. Resv. Stor.}}{\text{Vol. of Inflow}} = 0.14$

Req. Resv. Stor $= 0.14 \times 14,800 = 2,072$ ac. ft.

70% PMF $0.7 \times PMF = 0.7 \times 39,400 = 27,580$ cfs

Vol. Runoff $= 0.7 \times 29,500 = 20,650$ ac. ft.

$\frac{\text{Max Spill. Q}}{\text{0.7 PMF peak}} = \frac{16,900}{27,580} = 0.61$

$\frac{\text{Req Resv. Stor.}}{\text{Vol. of Inflow}} = 0.39$

Req. Resv. Stor. $= 0.39 \times 20,650$
$= 8,050$ ac. feet.

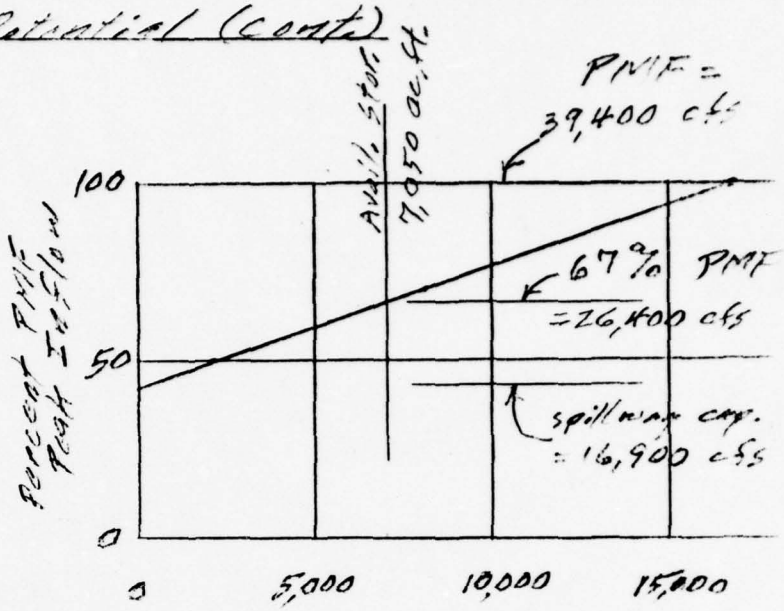
See graph on next sheet.

PROJECT _____ SHEET NO. 6 OF 4

SUBJECT Pelham Dam - Clark Creek - I.D. No. 561

COMPUTED BY PES DATE 8-17-78 CHECKED BY _____

Overtopping Potential (cont'd)



APPENDIX C

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Mauch Chunk Formation.

Lithology: Grayish red and reddish brown sandstone interbedded with similarly colored siltstone, mudstone, and shale. Some thin interbeds of green to grayish green mudstones are common. Cement in the sandstones consists of hematite and silica.

Structure

The dam is located on the northern limb of the Cove Mountain Syncline. The beds here strike N65°E and dip steeply southeast. Local reversals of dip, and faulting parallel to bedding strike may be present in these, but have not been mapped in this area.

Air photofracture traces have the following trends: N10°E, N30°W, N45°W and N80°W.

Overburden

On the north side of the valley the overburden consisted chiefly of weathered bedrock. Core boring logs indicate eight or nine feet of clay and "soft red shale". On the south side there were 10 to 28 feet of colluvium, clay and boulders, above the bedrock. The degree of weathering of the bedrock below the colluvium was not noted.

Aquifer Characteristics

While some of the sandstone units in the Mauch Chunk Formation may have some primary porosity and permeability, most, or all, of the ground water movement is along bedding planes and fractures. Since the grains and cement of the rock are essentially insoluble minerals, there is little chance of enlargement of fractures by ground water movement.

Discussion

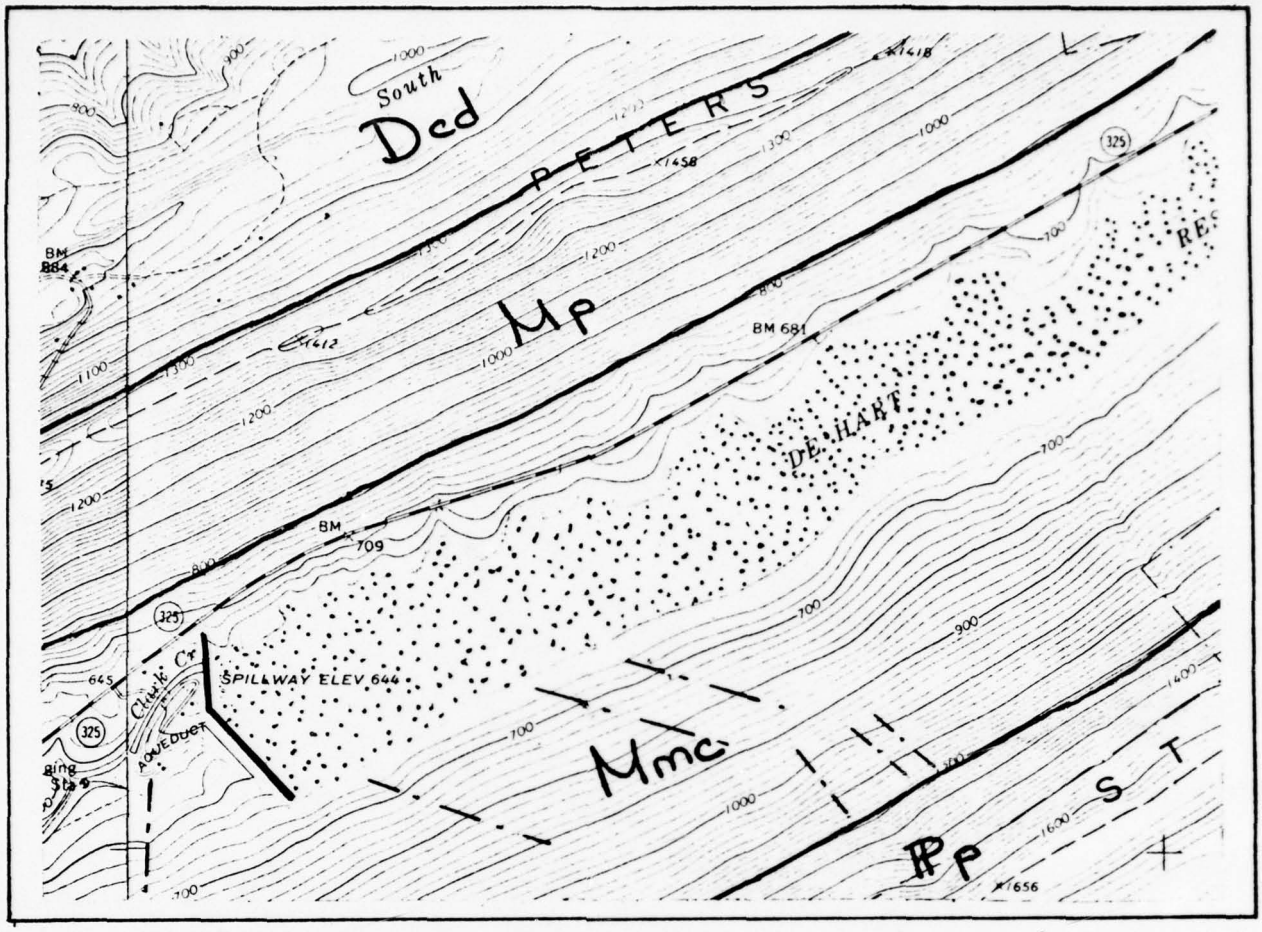
The plans for this dam indicate the cutoff trench was to be dug to fresh rock, and that grout holes were to be drilled 25 feet below the floor of the trench. Because the dam axis is nearly perpendicular to the bedding, and some of the fracture directions also intersect the dam, there is a possibility of some leakage through the bedrock below the grout curtain. Such leakage would not be cause for concern, however, because of the sound nature of the rock.

Sources of Information

1. Open file geologic map of the Grantville Quadrangle; Pa. Geological Survey, Harrisburg, Pa.

2. Core Boring Logs, in file.

3. Air Photographs, scale 1:24,000 dated, 1968.



(geology from open file maps, Pa. Geol. Surv.)

Mp	Pocono Fm.
Ppp	Pottsville Fm.
Mmc	Mauch Chunk Fm.
Dcd	Catskill Fm.

—·—·— air photo fracture trace

N

SCALE 1:24 000

1 0 1 MILE

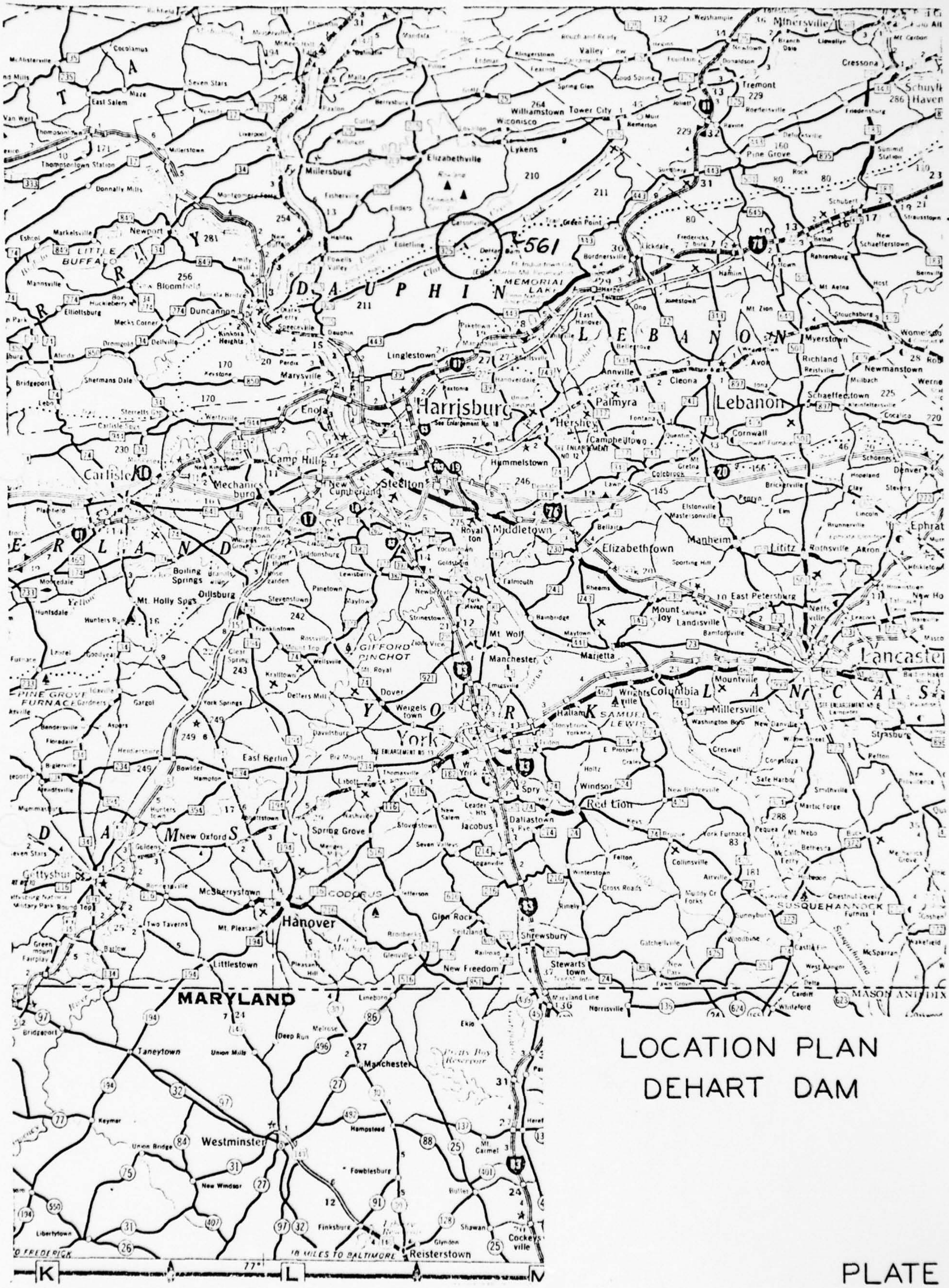
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

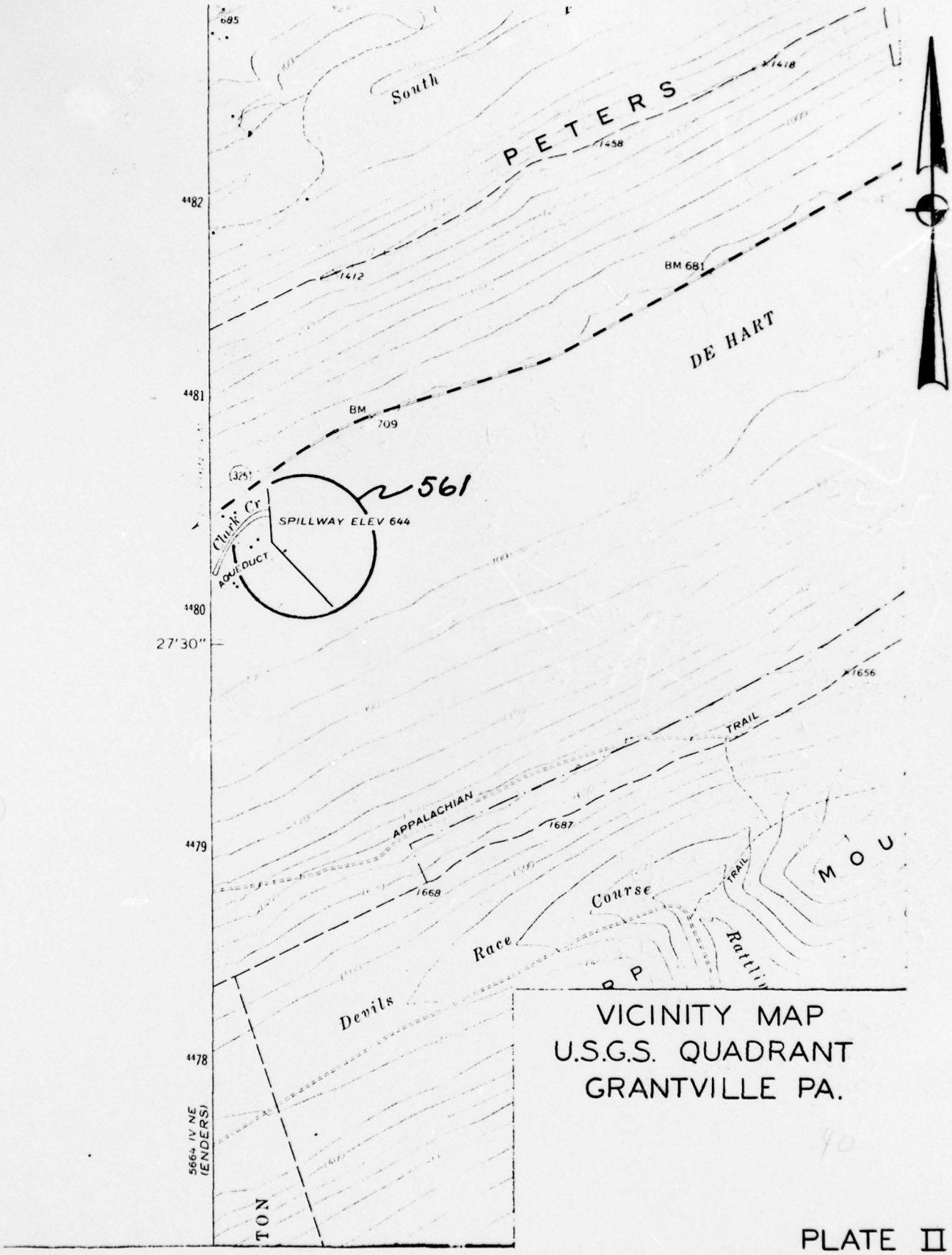
APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS



LOCATION PLAN
DEHART DAM

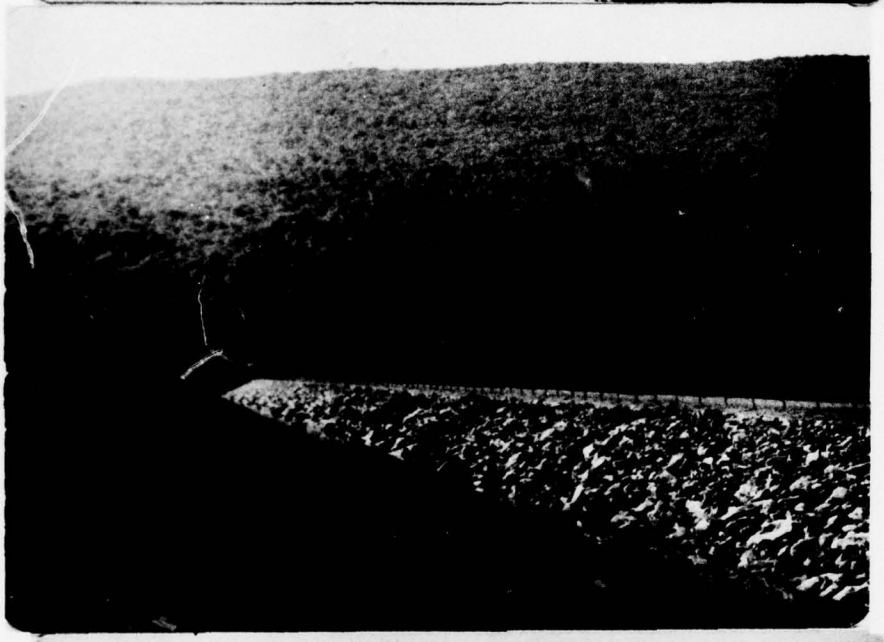
PLATE I



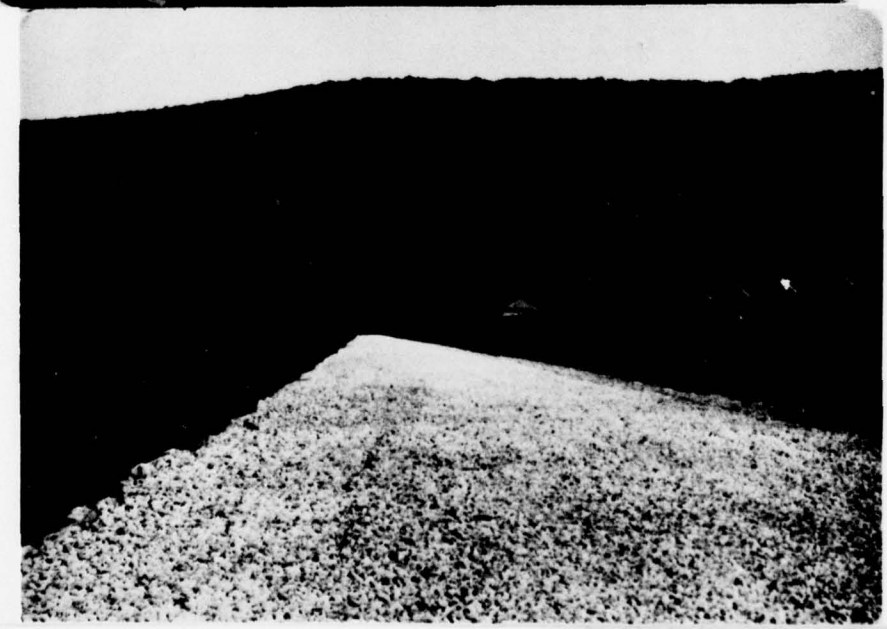
VICINITY MAP
U.S.G.S. QUADRANT
GRANTVILLE PA.

PLATE II

Reservoir



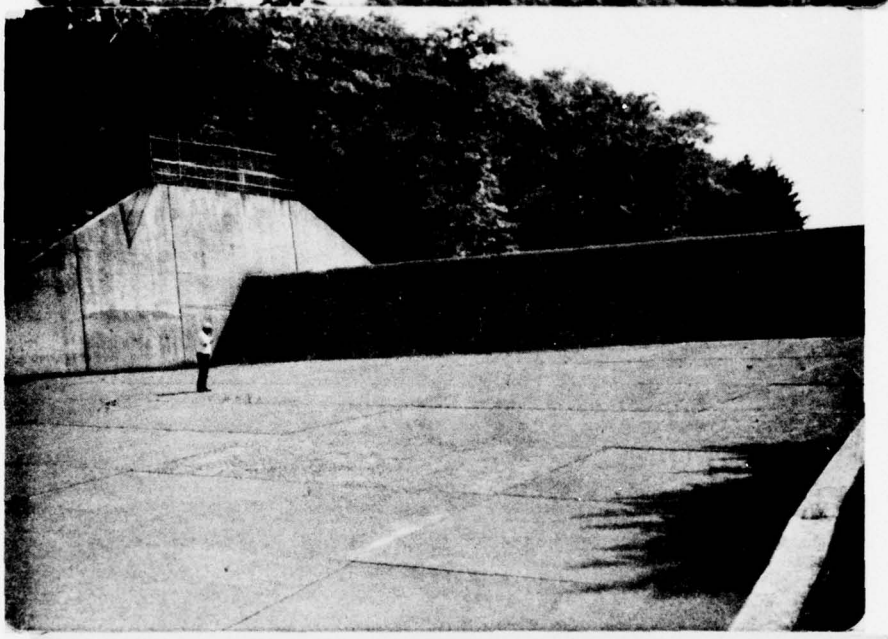
Upstream
Embankment



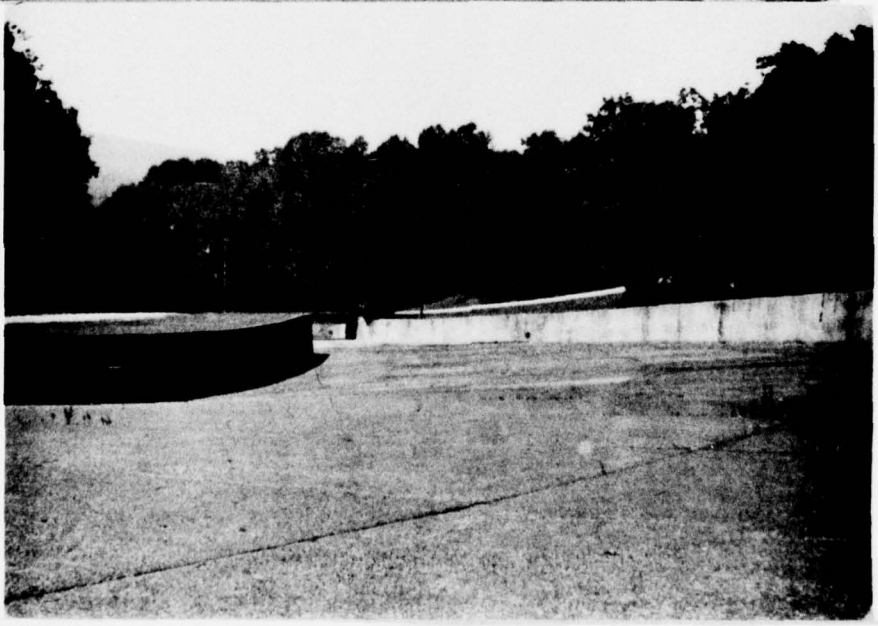
Top of Dam

PLATE III

Downstream Slope



Spillway

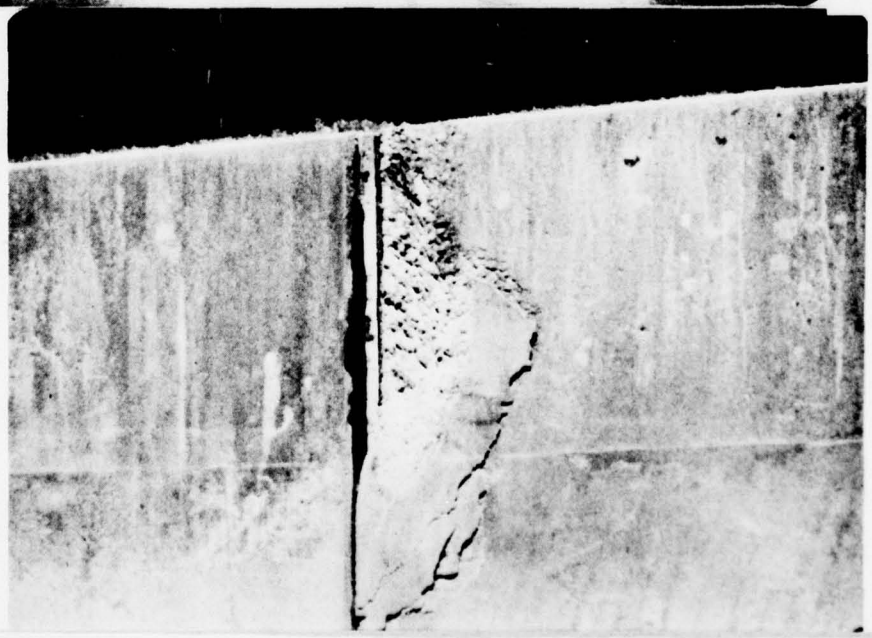


Spillway Channel

PLATE IV

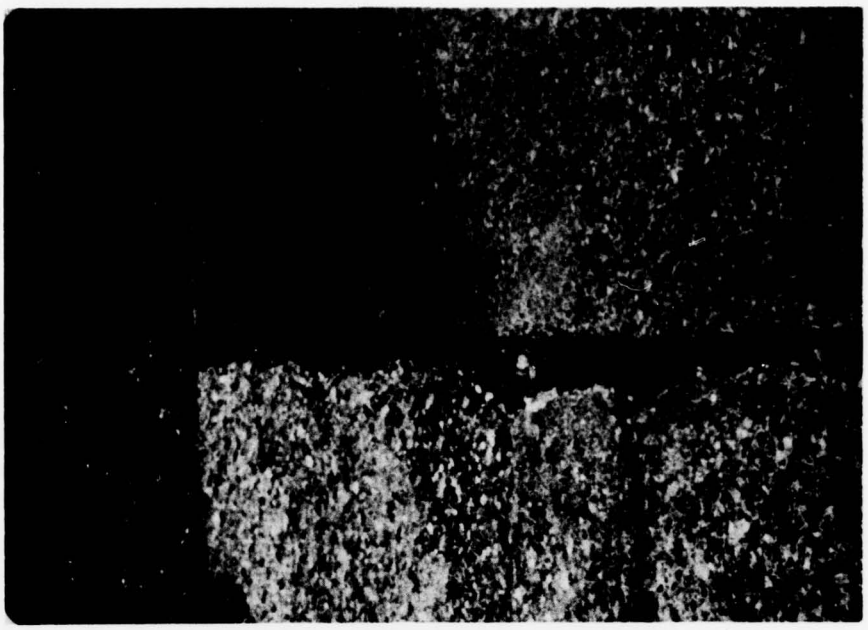
Spillway
Channel

Spillway
Channel



Spillway
Wall Joint

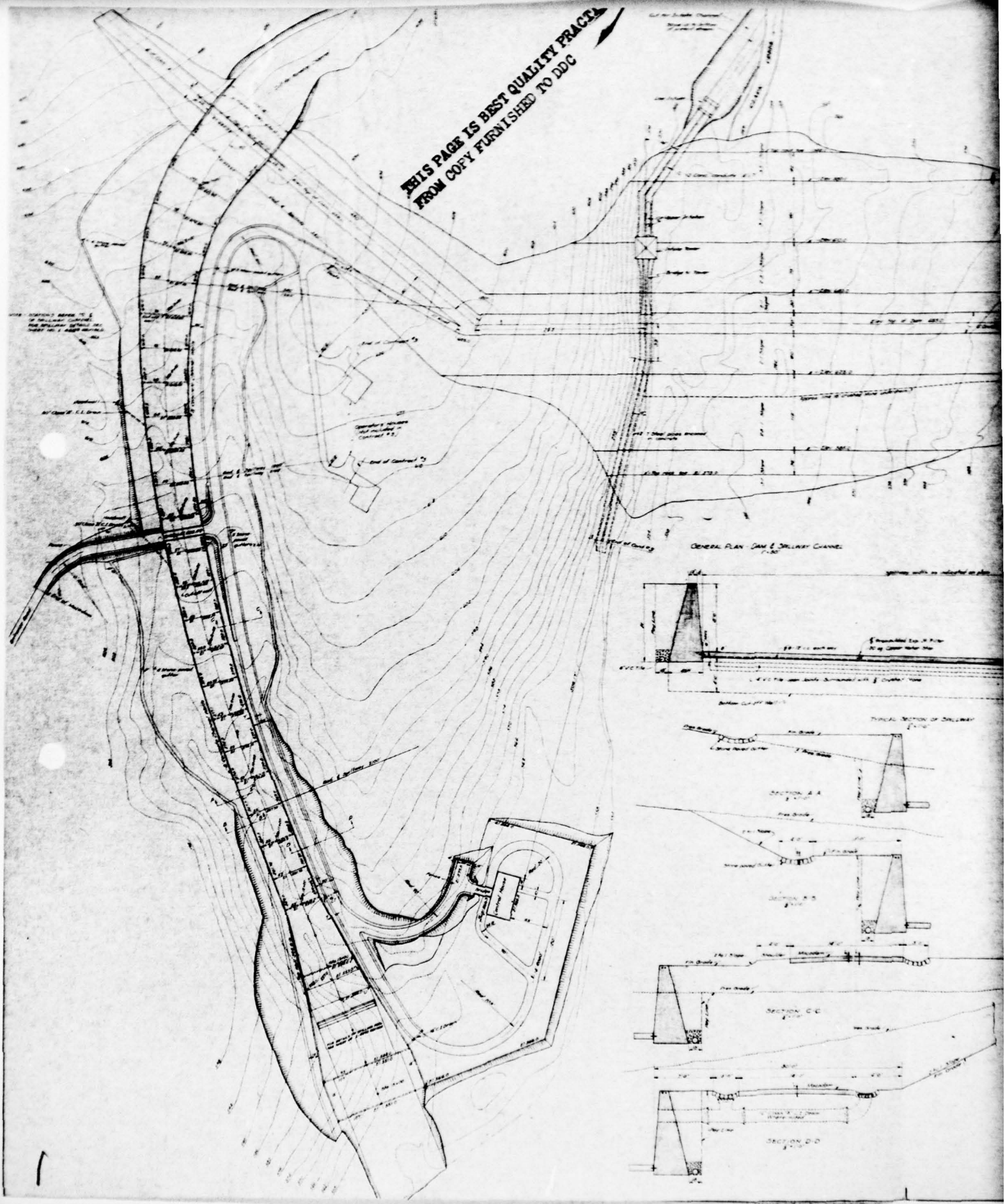
PLATE V

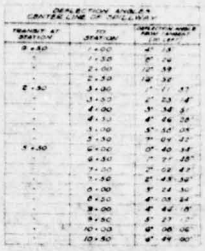


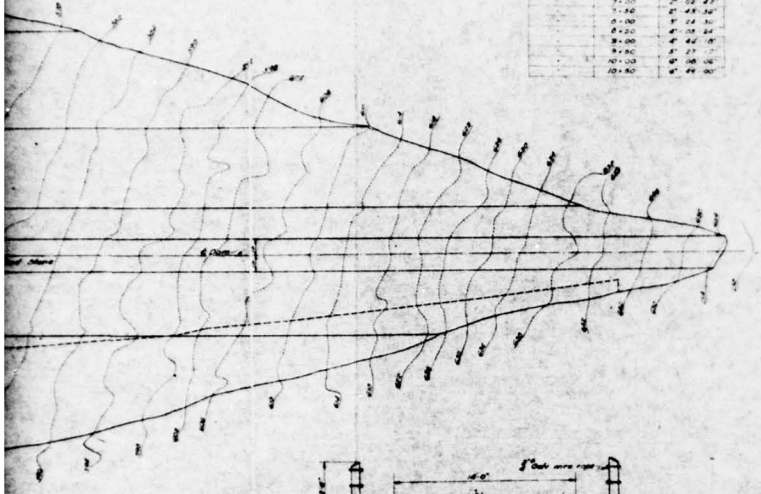
Spillway Slab Joint

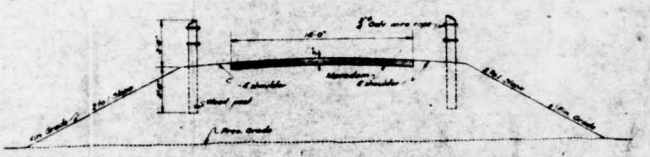
Downstream Channel

PLATE VI

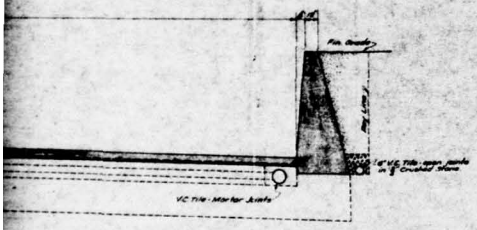


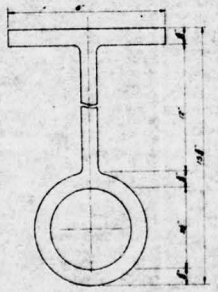




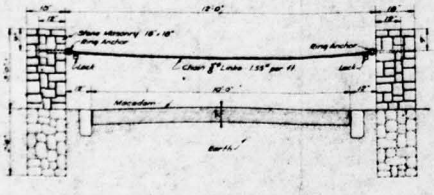


SECTION C-C
1"=10'





FORGED STEEL RING ANCHOR
1"=1'



DETAIL OF POSTS AT FOOT OF ROAD TO DAM
1"=1'0"

Except as noted, all slopes on earthwork fills 2 to 1
Widths shown on spillway are at bottom
For details of bridge over spillway see Sheet No. 2 of 10
Datum
Contours show original ground

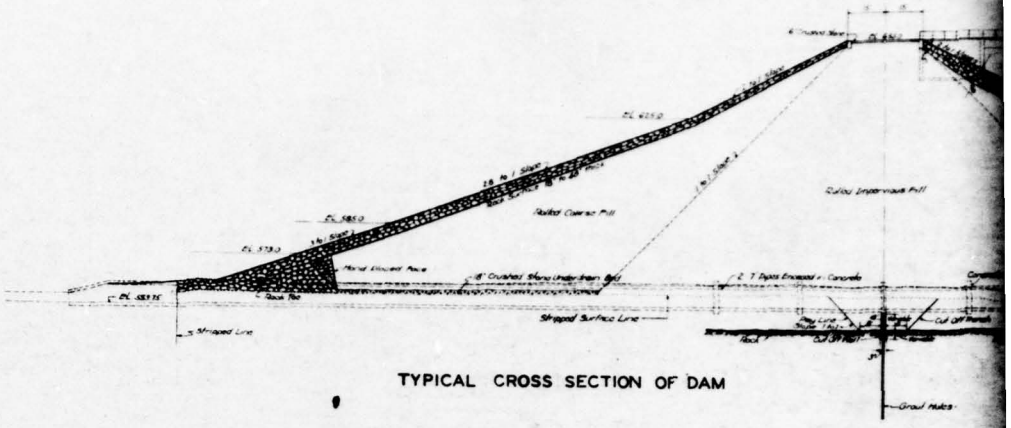
PLATE VII

THE CITY OF HARRISBURG
DAUPHIN COUNTY, PA.
WATER SUPPLY PROJECT

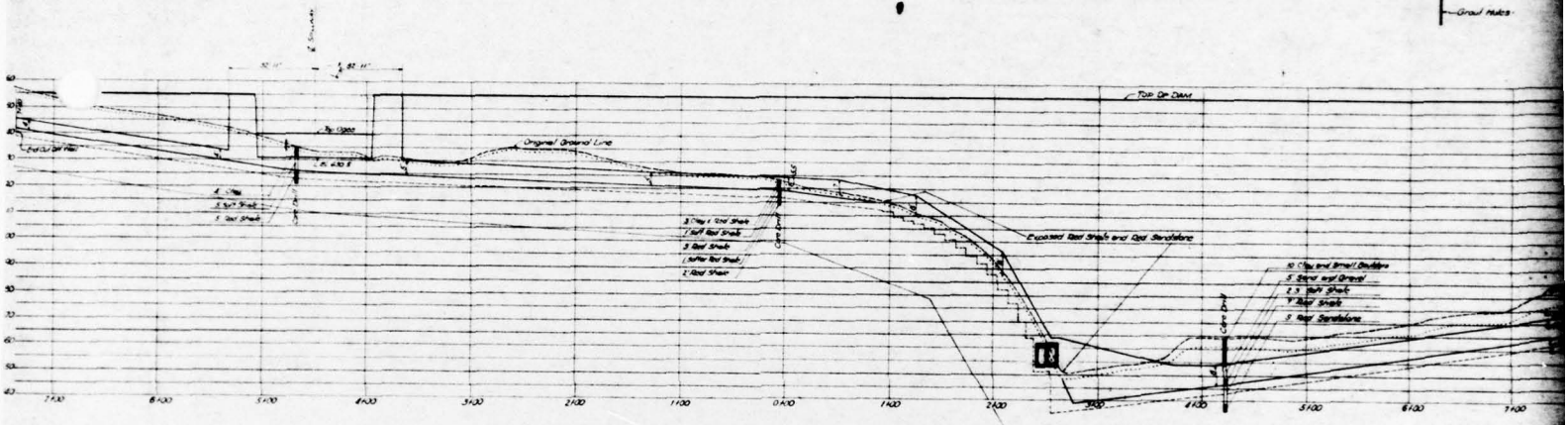
GENERAL PLAN OF DAM

DATE - JUNE 1939. SCALE - AS SHOWN.

GANNETT, EASTMAN & FLEMING, INC.
PROJECT ENGINEERS
HARRISBURG, PA.

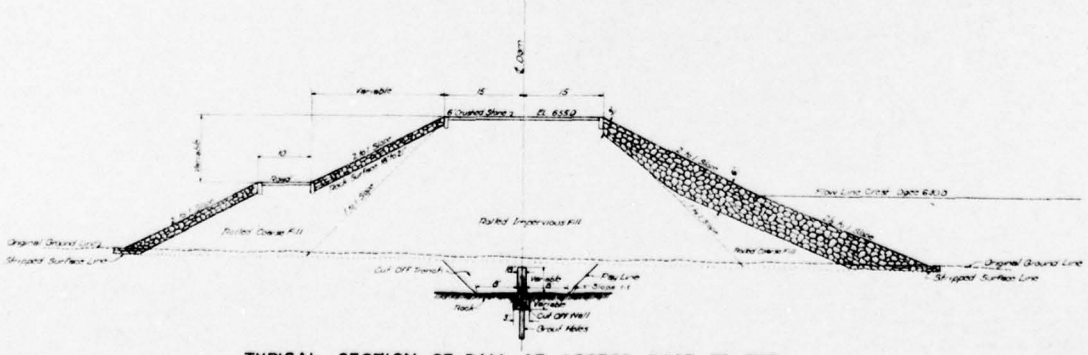


TYPICAL CROSS SECTION OF DAM



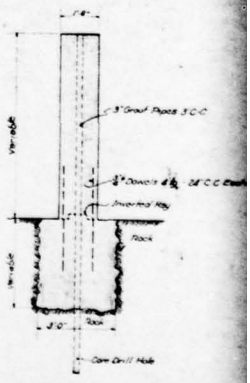
TRANSVERSE PROFILE OF VALLEY ON CENTER OF DAM

SCALE { VERTICAL 1" = 20'
HORIZONTAL 1" = 50'



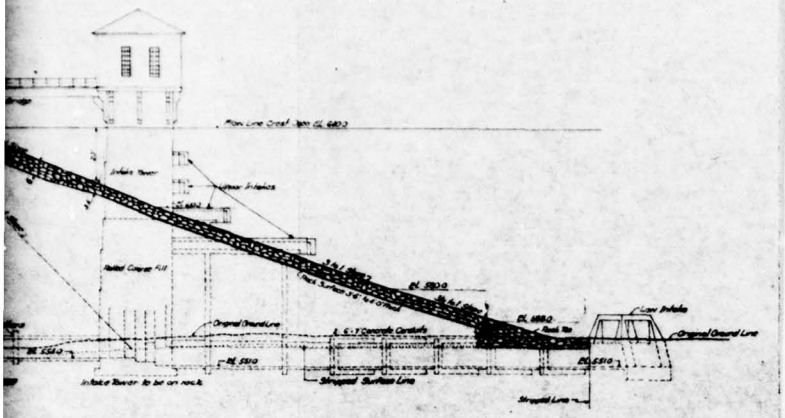
TYPICAL SECTION OF DAM AT ACCESS ROAD TO TOP

SCALE 1" = 10'

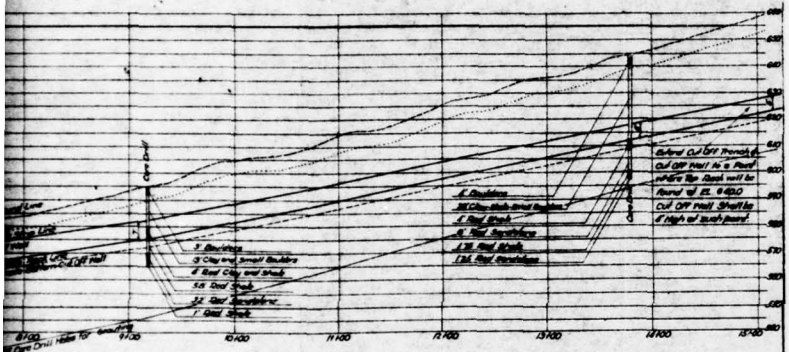


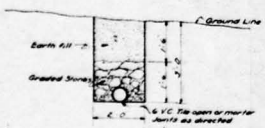
TYPICAL SECTION OF CUT OFF WALL

SCALE 1/2" = 1



SCALE 1" = 20'





DETAIL BLIND DRAIN
SCALE 1/2" = 1'-0"

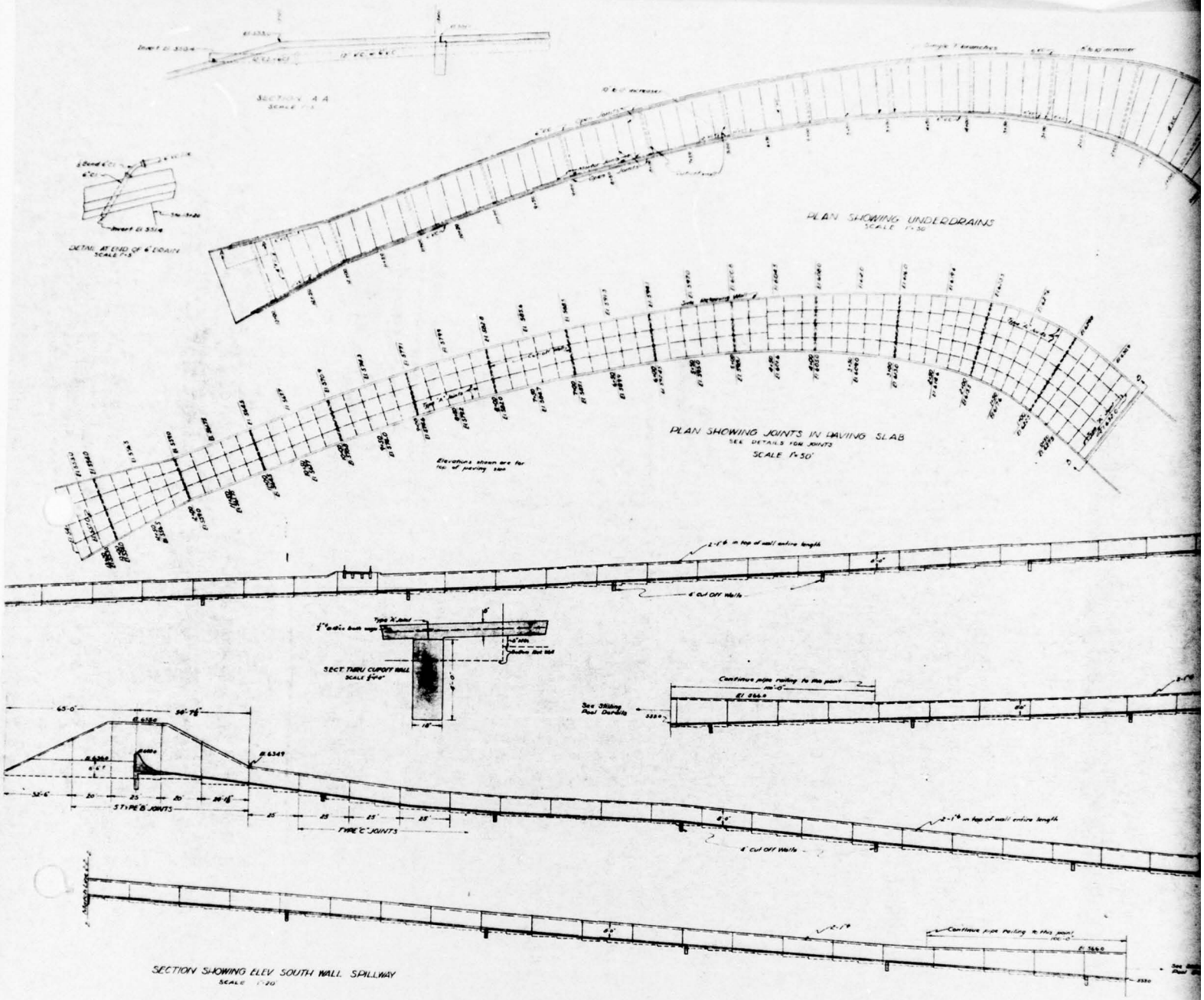
PLATE VIII

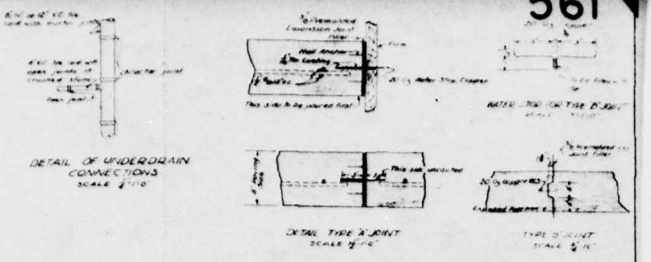
THE CITY OF HARRISBURG
DAUPHIN COUNTY, PA.
WATER SUPPLY PROJECT

SECTIONS OF DAM

DATE MARCH 1939 SCALE AS SHOWN

GANNETT, FLEMING, CORDDRY & CARPENTER, INC.
PROJECT ENGINEERS
HARRISBURG, PA.

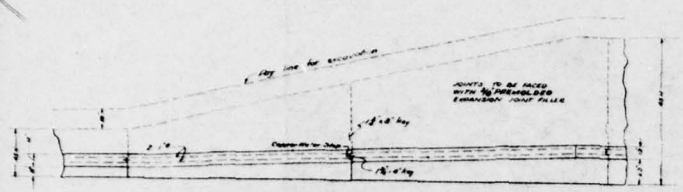




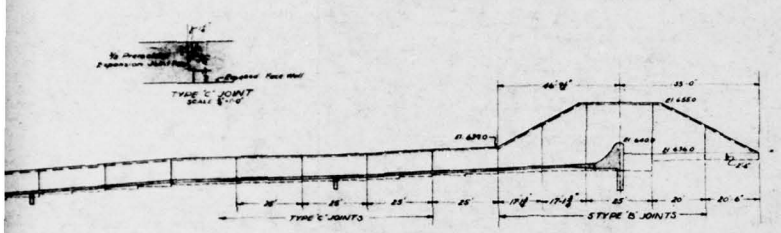
DETAIL OF UNDERDRAIN CONNECTIONS
SCALE 1/2"=1'-0"

DETAIL TYPE 'A' JOINT
SCALE 1/2"=1'-0"

TYPE 'B' JOINT
SCALE 1/2"=1'-0"



PART PLAN NORTH RETAINING WALL SHOWING TYPE 'B' JOINT
SCALE 1/4"=1'-0"



TYPE 'C' JOINT
SCALE 1/2"=1'-0"

SECTION SHOWING ELEVATION NORTH WALL SPILLWAY
SCALE 1"=10'

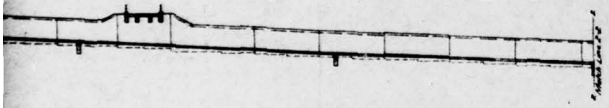


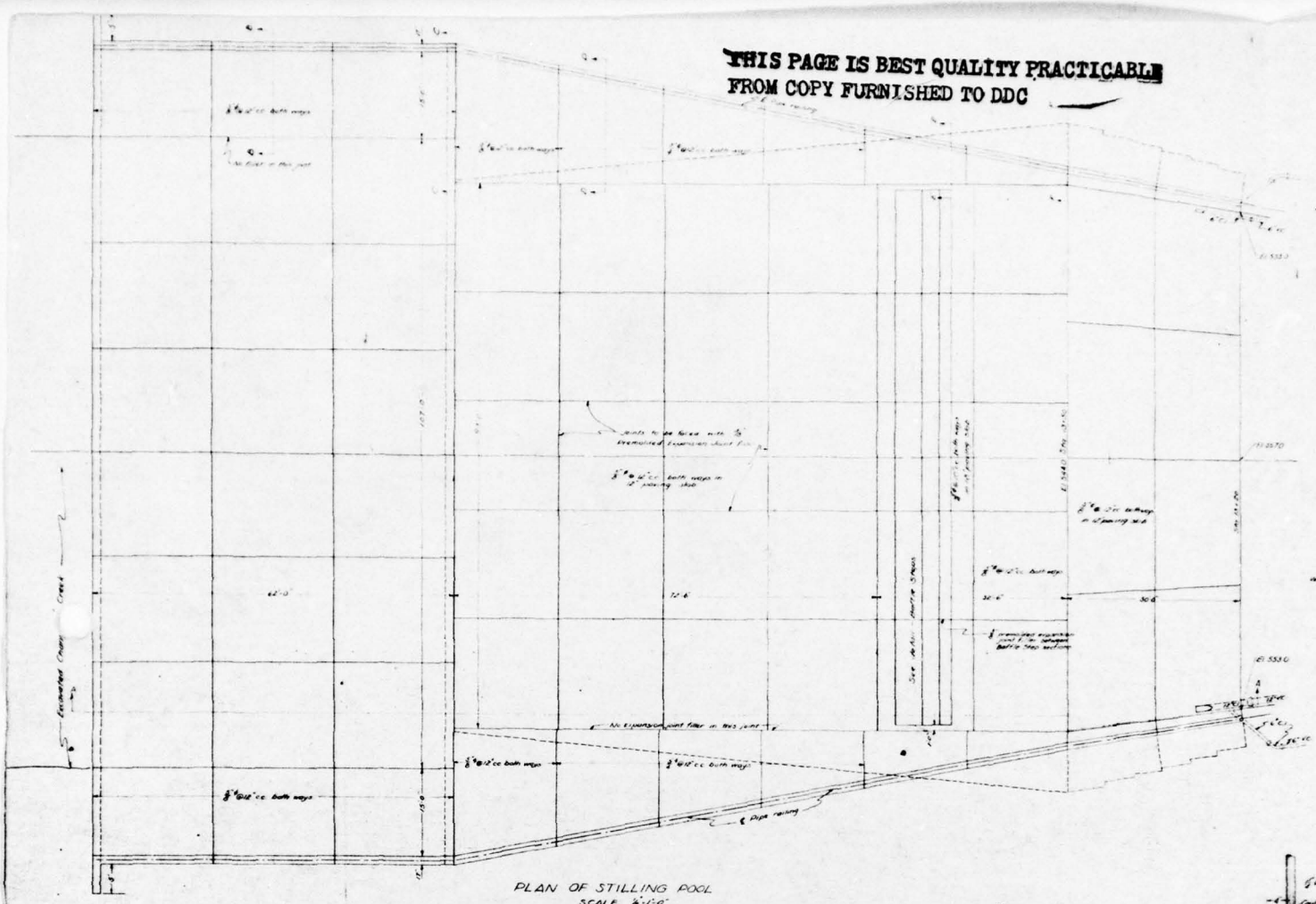
PLATE IX

THE CITY OF HARRISBURG
DAUPHIN COUNTY, PA.
WATER SUPPLY PROJECT

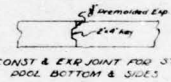
SPILLWAY
CHANNEL DETAILS

DATE JUNE 1939 SCALE AS SHOWN

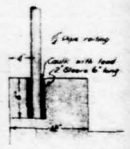
GANNETT, EASTMAN & FLEMING
PROJECT ENGINEERS
HARRISBURG, PA.



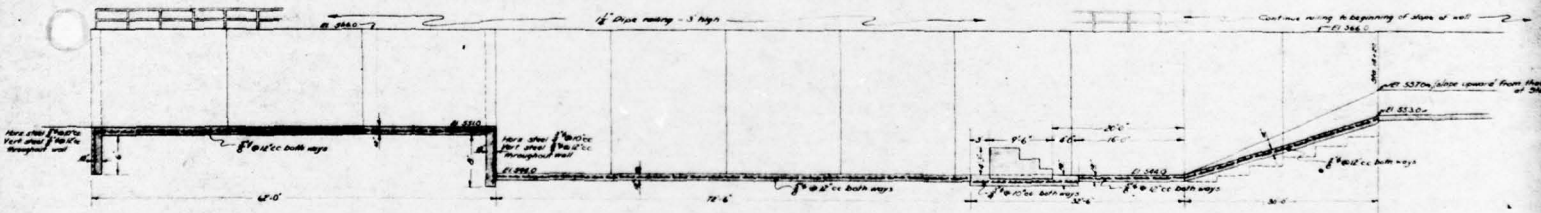
PLAN OF STILLING POOL
SCALE 1/8"=1'-0"



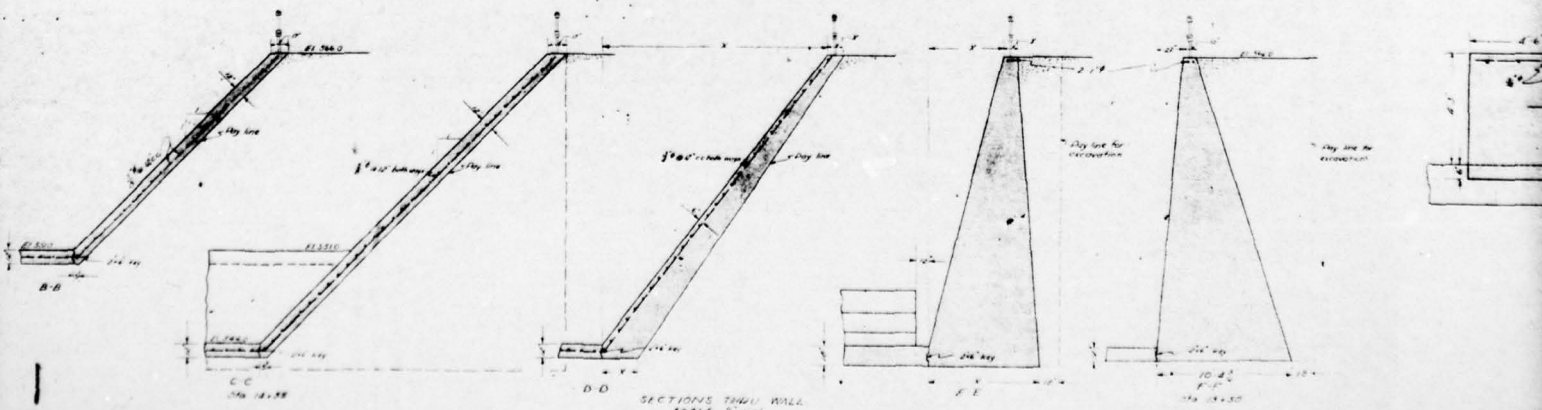
CONST & EXP JOINT FOR STILLING POOL BOTTOM & SIDES



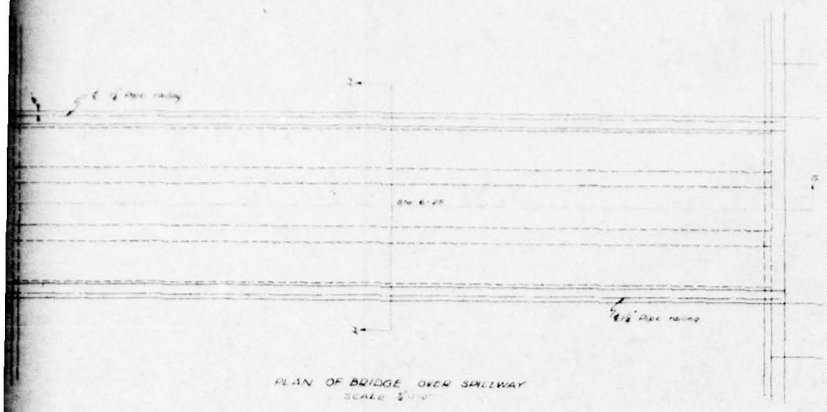
DETAIL OF RAILING SOCKET
SCALE 1"=1'-0"



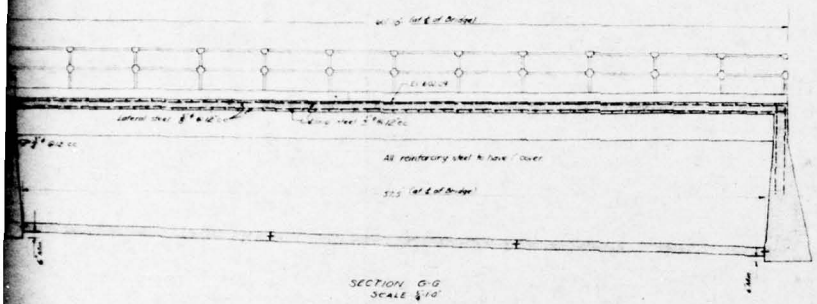
SECTION A-A
SCALE 1/8"=1'-0"



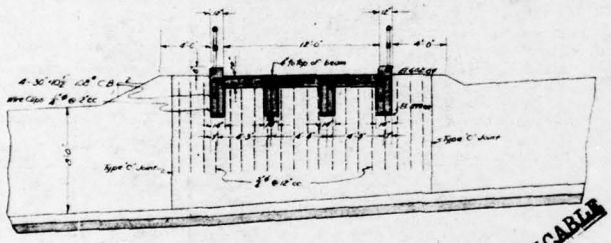
SECTIONS THRU WALL
SCALE 1/8"=1'-0"



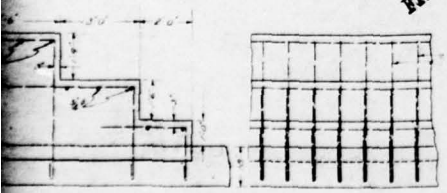
PLAN OF BRIDGE OVER SPILLWAY
SCALE 1/4"=1'-0"



SECTION G-G
SCALE 1/4"=1'-0"



SECTION H-H
SCALE 1/4"=1'-0"



DETAIL OF BAFFLE STEPS
SCALE 1/4"=1'-0"

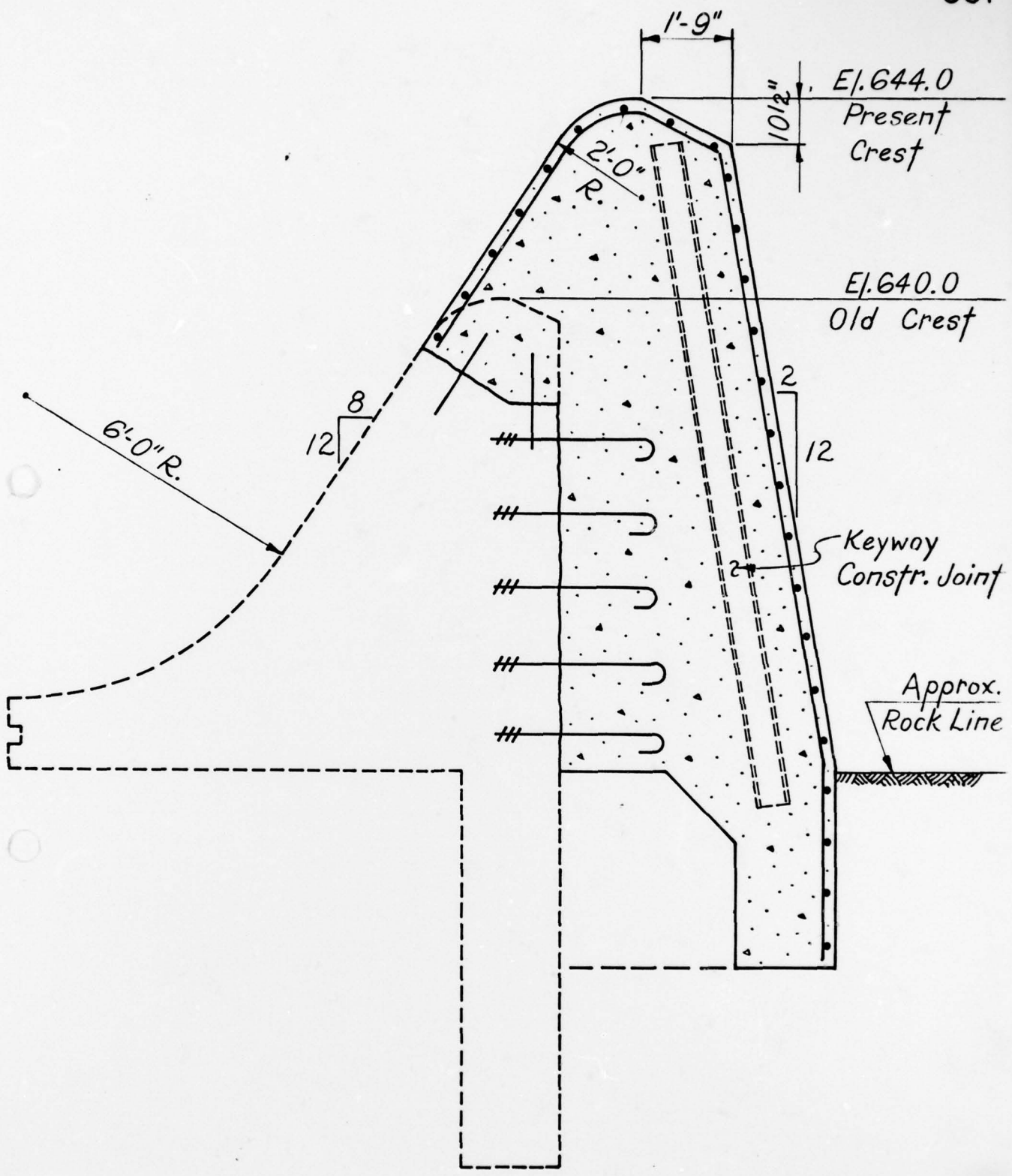
PLATE X

THE CITY OF HARRISBURG
DAUPHIN COUNTY, PA.
WATER SUPPLY PROJECT

STILLING POOL AND
SPILLWAY BRIDGE DETAILS

DATE JUNE 1939 SCALE AS SHOWN

GANNETT FLEMING CORBETT & FLEMING, INC.
PROJECT ENGINEERS
HARRISBURG, PA.



SPILLWAY RAISING 1954

Scale: 3/8" = 1'-0"

PLATE XI